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30 CFR Parts 56, 57, 62, 70 and 71

Health Standards for Occupational Noise Exposure in Coal, Metal, and Nonmetal Mines; Proposed Rule

DEPARTMENT OF LABOR

Mine Safety and Health Administration

30 CFR Parts 56, 57, 62, 70 and 71

RIN 1219–AA53

Health Standards for Occupational Noise Exposure

AGENCY: Mine Safety and Health Administration (MSHA), Labor.

ACTION: Proposed rule.

SUMMARY: This proposed rule would replace MSHA's existing standards for occupational noise exposure in coal mines and in metal and nonmetal mines with a single new standard applicable to all mines.

This action is part of the Agency's ongoing review of its safety and health standards. The review found that the Agency's existing noise standards, which had been promulgated more than 20 years ago, are inadequate to prevent the occurrence of occupational noise-induced hearing loss (NIHL) among miners. There remains a significant risk to miners of material impairment of health from workplace exposure to noise over a working lifetime. The risk becomes significant when exposure exceeds an 8-hour time-weighted average of 85 dBA.

DATES: Comments must be received on or before February 18, 1997. Submit written comments on the information collection requirements by February 18, 1997.

ADDRESSES: Comments on the proposed rule may be transmitted by electronic mail, fax, or mail. Comments by electronic mail must be clearly identified as such and sent to this e-mail address: noise@msha.gov. Comments by fax must be clearly identified as such and sent to: Mine Safety and Health Administration, Office of Standards, Regulations, and Variances, 703–235–5551. Send mail comments to: Mine Safety and Health Administration, Office of Standards, Regulations, and Variances, Room 631, 4015 Wilson Boulevard, Arlington, VA 22203–1984. Interested persons are encouraged to supplement written comments with computer files or disks; please contact the Agency with any questions about format. Written comments on the information collection requirements may be submitted directly to the Office of Information and Regulatory Affairs, OMB New Executive Office Building, 725 17th Street, NW., Rm. 10235, Washington, D.C. 20503, Attn: Desk Officer for MSHA.

FOR FURTHER INFORMATION CONTACT: Patricia W. Silvey, Director; MSHA; Office of Standards, Regulations, and Variances; 703–235–1910.

SUPPLEMENTARY INFORMATION:

Comprehensive Summary

The proposal would retain the existing permissible exposure level (PEL) but establish a new ''action level''. The action level would be an 8-hour time-weighted average of 85 dBA; the PEL would remain an 8-hour time-weighted average of 90 dBA.

Whenever a miner's noise exposure exceeds the action level, the miner would receive special training in noise protection.

When the miner's noise exposure exceeds the action level, but is below the PEL, the operator would be required to make annual audiometric (hearing) examinations available to the miner through enrollment in a hearing conservation program, and to provide properly fitted hearing protection in three circumstances—before the initial hearing examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon miner request. If it will take more than 6 months for the initial examination because of the need to wait for a mobile test van, or a significant threshold shift in hearing acuity is detected, the operator would also be required to ensure the miner uses the provided hearing protection.

If a miner's exposure exceeds the PEL, the proposal would require that the mine operator use all engineering and administrative controls which it is feasible for that mine operator to utilize to reduce noise to the PEL. The proper combination of engineering and administrative controls would be left to the discretion of the mine operator.

Should the use of all feasible engineering and administrative controls not reduce a miner's noise exposure to the PEL, the operator would have to use those controls to lower exposure to as close to the PEL as is feasible. In addition, the operator would have to provide any such miner properly fitted hearing protection, ensure the miner uses such protection, and ensure the miner takes the annual audiometric examinations. Should a miner's exposure exceed an 8-hour time-weighted average of 105 dBA, the operator must ensure the miner is provided and uses both a plug and a muff type protector.

MSHA recognizes that successful implementation of these new uniform health rules will require training of MSHA personnel and guidance to miners and mine operators, particularly small mine operators. Accordingly, the Agency proposes that the final rule take effect one year after the date of publication of the final rule, and solicits comments on whether a phased-in approach would permit some elements of the new rule to be implemented more quickly.

The Supplementary Information accompanying this notice is detailed. Accordingly, to facilitate review and comment by the mining community, this material begins with questions and answers summarizing key points about the proposal. Included are two charts comparing the main features of the proposal to existing standards in the mining industry and those applicable to other industries under the Occupational Safety and Health Act. Also included are MSHA's estimates of the impacts of the proposal from the Agency's preliminary Regulatory Impact Analysis (RIA), copies of which are available from the Agency.

I. Questions and Answers, Required Notices, and History

(A) Questions and Answers About Key Features of this Proposal

(1) What Are the Key Features of This Proposal?

MSHA has developed a proposal that it estimates can reduce by two-thirds the number of miners currently projected to suffer a material impairment of their hearing—but which it estimates can be implemented at a cost of less than $9 million to the mining industry as a whole.

The focus of the proposal is on the use of the most effective means to control noise—engineering controls to eliminate the noise, or administrative controls (e.g. rotating miner duties) to minimize noise exposure—whenever feasible.

Specifically, the proposal requires that an operator use all feasible engineering or administrative controls to reduce noise to the PEL—a TWA_8 of 90 dBA. While MSHA has determined there is a significant risk of harm at a TWA_8 of 85 dBA, the Agency believes that it may not be feasible at this time for the mining industry to control noise to this level using engineering and administrative controls.

The proposal would require that steps be taken when noise exceeds a TWA_8 of 85 dBA, the ''action level'', to prevent hearing loss. Operators would have to provide special instruction in noise, make annual hearing examinations available, and provide properly fitted hearing protection—before the initial examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon a miner's

request. If it will take more than 6 months to take the initial examination because of the need to wait for a mobile test van, or if a significant threshold shift is detected, an operator would also be required to ensure that the miner uses the hearing protection.

The proposal also provides for supplemental protection in those cases in which individual operators are unable to reduce noise to the PEL through the use of all feasible engineering or administrative controls. The operator must ensure any miner so exposed takes the annual hearing examinations, must provide properly fitted hearing protection to all miners so exposed, and must ensure the hearing protection is used by all miners so exposed.

The focus on engineering and administrative controls would significantly change the way noise is addressed in the coal mining industry. Currently, hearing protectors generally are allowed when a coal miner's noise exposure exceeds the PEL. The proposal would require a coal mine operator to use all feasible engineering and administrative controls to reduce exposure to the PEL—the practice currently required in the rest of the mining industry. MSHA estimates that this change alone can prevent 3 out of every 5 impairments projected to occur due to occupational noise exposure in the coal mining industry.

While this change would cost the coal mining industry more money for implementation of engineering controls, MSHA estimates these costs would be significantly offset by the paperwork savings the coal mining industry will accrue under the proposal. In particular, MSHA is proposing to replace the costly, paperwork-intensive requirements for biannual coal miner noise exposure surveys, supplemental noise surveys, calibration reports, survey reports, and survey certifications with a performance-oriented requirement that mine operators establish a monitoring program that effectively evaluates miner exposures. MSHA believes the existing requirements have not been effective.

Other parts of the proposal would change current practices throughout the mining industry. No actions are currently required if noise exposures are below the PEL. Moreover, the proposal requires, for the first time, certain explicit protections if an operator cannot feasibly reduce noise exposures to the PEL through the use of all feasible engineering and administrative controls.

MSHA's proposal also incorporates revisions warranted by our increased understanding of the effects of noise, to the extent that the Agency determined such changes would be feasible for the mining industry to implement. For example, to reflect that exposure to sound levels above 80 dBA is now generally recognized as harmful, the proposal would include exposure to such sound levels in determining a miner's noise dose. Such adjustment will result in more miners than at present being determined to have noise exposures over the PEL, but the Agency has determined that the industry can feasibly accommodate this change.

(2) Do I Need To Read This Entire Notice To Understand the Proposal?

The Agency hopes these questions and answers will provide the information most of the mining community will want. Nevertheless, MSHA is accompanying publication of this proposed rule with a detailed discussion of the information it has considered in developing the proposal. That way, those interested in a particular topic can have the benefit of the Agency's thinking in developing their comments.

The information is divided into five parts. Part I includes a review of the projected impacts of the proposal, including benefits, costs and paperwork, taken from the Agency's preliminary RIA. Part II is the Agency's analysis of the current risks to miners from occupational noise exposure. Part III is a section-by-section discussion of the elements of the proposal. Part IV is an analysis of the technological and economic feasibility of the proposal and of key alternatives considered by the Agency. Part V is a complete list of publications referenced by the Agency.

(3) What Are the Projected Impacts of the Proposed Rule?

The estimated benefits and costs and paperwork requirements of the proposed rule are summarized in the following table, ''Summary of Key Impacts of MSHA's Noise Proposal,'' followed by a brief explanation. The Agency's estimates, and a complete description of the methodology used to obtain them, are contained in the Agency's preliminary RIA, a copy of which can be obtained from the Agency.

SUMMARY OF KEY IMPACTS OF MSHA'S NOISE PROPOSAL *

	Coal	Metal/nonmetal	All mining
Benefits:			
% hearing impairments avoided	81	57	67
# miners saved from hearing impairment	15,300	15,300	30,600
Annual costs (in millions of dollars)	$0.3	$8	$8.3
Paperwork burden hours added/saved	(88,740)	73,755	(14,985)

* Rounded.

The analysis of benefits compares the number of miners who are projected to incur a material impairment of their hearing under the current rule with the number of miners who are projected to incur such an impairment under the proposed rule. Overall for the mining community, the proposal would reduce the risk of material impairment by 67%. More than 30,000 miners otherwise expected to develop a material impairment would be spared.

As displayed in the chart entitled ''Benefits of MSHA Noise Proposal in Saving Miners From Hearing Impairment,'' the most significant benefits are expected in the coal sector. Engineering and administrative controls are expected to significantly reduce noise exposures above the PEL. A significant benefit also accrues from the establishment of an action level: based on the assumption that most employees exposed to noise between the action level and the PEL will elect to use hearing protection for the first time at such levels. While the metal and nonmetal mining industry already uses engineering controls above the PEL, additional benefits are anticipated in this regard; primarily because the change in the way noise dose would be measured under the proposal would require the use of engineering and administrative controls in more cases than at present. Like coal, a benefit in

this sector is anticipated from the establishment of an action level.

As indicated by this chart, MSHA projects that even after implementation of the proposal some miners will continue to develop a material impairment of hearing. This is of serious concern to the Agency. The Agency believes, however, that the mining industry may not be able at this time to feasibly take actions which would eliminate the remaining risk (see response to Questions 9 and 13 on this point). MSHA is seeking comments on this issue.

BENEFITS OF MSHA NOISE PROPOSAL IN SAVING MINERS FROM HEARING IMPAIRMENT

		Miners
Coal:		
Current expected impairment	15% of miners	18,947
Saved by eng/admin controls	58% of projected impairment	11,072
Saved by hearing protectors	22% of projected impairment	4,232
Saved by proposal	81% of projected impairment	15,304
Remaining expected impairment	3% of miners	3,643
Metal and Nonmetal:		
Current expected impairment	13% of miners	26,977
Saved by eng/admin controls	11% of projected impairment	2,693
Saved by hearing protectors	46% of projected impairment	12,320
Saved by proposal	57% of projected impairment	15,283
Remaining expected impairment	6% of miners	11,694
Mining Industry as a Whole:		
Current expected impairment	14% of miners	45,924
Saved by eng/admin controls	31% of projected impairment	14,035
Saved by hearing protectors	36% of projected impairment	16,552
Saved by proposal	67% of projected impairment	30,587
Remaining expected impairment	5% of miners	15,377

MSHA's estimates of cost follow a standard approach in which initial costs of compliance (like equipment purchase costs) are amortized over ten years at seven percent and added to costs that recur each year. The assumptions on what controls would be needed, how many hours have to be spent on particular tasks, and the costs of the personnel performing various tasks are set forth in detail in the Agency's preliminary RIA.

MSHA estimates that the proposed rule would increase the mining industry's costs by approximately $8.3 million annually for the first 10 years. MSHA estimates the proposed rule will cost the coal mining industry about $300,000 a year; because while there will be additional costs under the proposal, they will be significantly offset by the elimination of the requirements for biannual noise surveys of coal miners. Costs to the metal and nonmetal industry would rise by about $8 million annually.

The most costly aspect of the proposed rule would be the provision of audiometric examinations—about $3.6 million, with about $2 million of that borne by the metal and nonmetal mining industry. The provision of engineering controls is estimated to cost about $3.5 million, with about $2.2 million of this borne by the coal mining industry—which would no longer be permitted, as at present, to substitute hearing protectors for engineering or administrative controls. MSHA's costing assumptions are described in its preliminary RIA; comments on this methodology are being solicited.

The table entitled ''Cost Impacts of MSHA Noise Proposal'' summarizes the net annual costs of the proposal's requirements. An explanation of the requirements is included in the questions and answers that follow.

COST IMPACTS OF MSHA NOISE PROPOSAL

Task	Total cost	M/NM cost	Coal cost
Engineering Controls	$3,475,700	$1,289,000	$2,186,700
Dose Determination	(1,928,550)	1,734,895	(3,663,445)
Notification	45,910	28,085	17,825
Record of Noise Surveys, et al.	(1,653,565)	.....	(1,653,565)
Administrative Controls	16,595	6,580	10,015
HPDs (provide, selection, fit)	926,710	792,560	134,150
Training	1,834,560	1,071,140	763,420
Audiograms (base, annual); notice to miners	3,574,030	1,964,970	1,609,060
Audiometric Test Procedures	195,835	113,835	82,000
Evaluation of Audiogram	892,215	492,215	400,000
Follow-up Evaluation	145,780	78,865	66,915
Follow-up Corrective Measures	99,440	52,455	46,985
Notification of Results	138,710	74,340	54,370
Access to Records	23,710	18,865	4,845
Transfer of Records	5,040	2,950	2,090
Contractors	541,640	316,320	225,320
Total	8,323,760	8,037,075	286,685

MSHA's estimates of paperwork burden hours reflect the requirements and definitions in the Paperwork Reduction Act. Overall, the proposal would decrease paperwork requirements in the mining industry by about 14,985 burden hours. This reflects a savings to the coal mining industry of 88,740 burden hours, as a result of a proposal to eliminate

existing requirements for biannual surveys of coal miners and other various reports. The metal and nonmetal mining sector would have a net increase of about 73,755 burden hours. The chart entitled ''Paperwork Impacts of MSHA Noise Proposal'' summarizes the projected paperwork burdens.

PAPERWORK IMPACTS OF MSHA NOISE PROPOSAL

Section	Paperwork requirement and associated tasks	Coal	M/NM	Total
62.120	Evaluate miners' noise exposure; notify miner of overexposure, prepare and post administrative controls; give miners copy of administrative controls.	(140,545)	5,295	(135,250)
62.130	Prepare and file a training certification	4,000	6,270	10,270
62.140	Perform audiograms, notify miners to appear for testing and need to avoid high noise	30,655	39,275	69,930
62.150	Compile an audiometric test record, obtain a certification	3,930	5,245	9,175
62.160	Provide information and audiometric test record, perform audiometric retests	9,340	12,015	21,455
62.170	Perform audiometric evaluations and follow-up evaluations	475	570	1,045
62.180	Prepare a training certification for retrained miners, review effectiveness of engineering and administrative controls.	335	365	700
62.190	Inform miner of test results, inform miner of STS	2,715	3,585	6,300
62.200	Provide access to records	255	1,000	1,255
62.210	Transfer records	100	135	235
All	(any discrepancies due to rounding)	(88,740)	73,755	(14,985)

(4) What Special Consideration Did MSHA Give to Alternatives for the Smallest Mines?

MSHA estimates that as a result of this proposal, metal and nonmetal mines with less than 20 miners would incur an average cost increase of about $500 per year in annual costs and annualized first year costs. Coal mines with less than 20 miners would have an average savings per mine of about $30, reflecting the elimination of the numerous survey and paperwork requirements in the current noise rules for the coal sector.

MSHA compared the proposed costs for small mines in each sector to the estimated revenues and profits for small mines in each sector. MSHA did this at various size levels. In each case, the costs as a percentage of revenue are less than 1%, and the costs do not appear to have any appreciable impact on profits. Accordingly, for the purposes of the Regulatory Flexibility Act, MSHA has certified that the proposed rule does not have a significant economic impact on a substantial number of small entities.

The limited impacts on small mines reflect decisions by MSHA not to propose more costly regulatory alternatives. In considering regulatory alternatives for small mines, MSHA must observe the requirements of its authorizing statute. Section 101(a)(6)(A) of the Mine Act requires the Secretary to set standards which most adequately assure, on the basis of the best available evidence, that no miner will suffer material impairment of health over his/her working lifetime. In addition, the Mine Act requires that the Secretary, when promulgating mandatory standards pertaining to toxic materials or harmful physical agents, consider other factors, such as the latest scientific data in the field, the feasibility of the standard and experience gained under the Act and other health and safety laws. Thus, the Mine Act requires that the Secretary, in promulgating a standard, attain the highest degree of health and safety protection for the miner, based on the ''best available evidence,'' with feasibility a consideration.

As a result of this requirement, MSHA seriously considered two alternatives that would have significantly increased costs for small mine operators—lowering the PEL to a TWA_8 of 85 dBA, and lowering the exchange rate to 3 dB. In both cases, the evidence in favor of these approaches was strong. But in both cases, MSHA has tentatively concluded that it may not be feasible for the mining industry to accomplish these more protective approaches. The impact of these approaches on small mine operators was an important consideration in this regard.

Part IV of this preamble contains a full discussion of MSHA's preliminary conclusions about these alternatives. The graph labeled ''Effect of Alternative Exchange Rates and PELs on Allowable Exposure Times at Various Decibel Levels'' provides an indication of what the Agency's decisions in this regard mean in practice.

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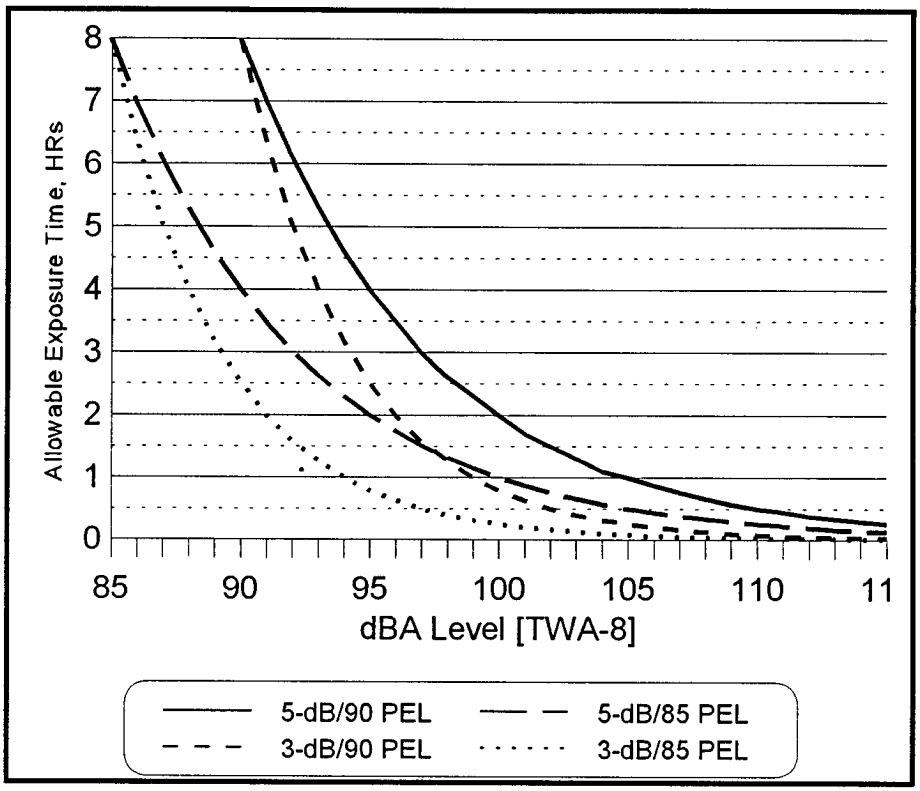

Effect of Alternative Exchange Rates and PELs on Allowable Exposure Time at Various Decibel Levels.

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In accordance with the Small Business Regulatory Enforcement and Fairness Act (SBREFA), MSHA is taking actions to minimize the compliance burden on small mines. The proposed effective date of the rule would be a year after final promulgation, to provide adequate time for small mines to achieve compliance. MSHA will also mail a copy of the proposed rule to every mine operator which primarily benefits small mine operators. MSHA is committed to writing the final rule in plain English so it can be readily understood by miners and mine operators. The Agency has committed itself to issuance of a compliance guide, and is inviting comment on whether compliance workshops or other such approaches would be valuable. (These proposed actions are discussed in more detail in other Questions and Answers.)

The approximately 350 small sand and gravel or crushed stone operations run by State, local and tribal governments may also be interested in MSHA's analysis on the impacts of the proposed rule on such entities. Such an analysis is required by the Unfunded Mandates Reform Act of 1995. Like other small metal and nonmetal mines, their costs for prevention of hearing loss are expected to average about $500 per year. Benefits to these governmental entities include fewer hearing impairments and reduced workers' compensation costs.

(5) Why Is the Proposed Rule Needed?

MSHA has concluded that the existing rules to protect miners from workplace noise exposure must be revised because current noise exposures continue to create a significant risk of material impairment of health to miners. MSHA estimates that 14% of U.S. miners—about 46,000 of them—can be expected under current exposure conditions to develop a material impairment of hearing during a working lifetime. The figures are 15% (19,000) of U.S. coal miners and 13% (27,000) of U.S. metal and nonmetal miners.

Generally, prolonged exposure to noise over a period of several years causes permanent damage to the auditory nerve and/or its sensory components: the higher the noise exposure the more rapid the loss. The loss may be so gradual, however, that a person may not realize that he or she is becoming impaired until a substantial amount of hearing is lost. This damage, known as noise-induced hearing loss or NIHL, is irreversible, and makes it difficult to hear as well as understand speech. In addition to the personal and social costs of hearing loss, the loss of the ability to understand speech can have a significant impact on miner safety which is highly dependent upon good communication.

The Agency has carefully analyzed the risk miners currently face of incurring such harm. What follows is a short summary of MSHA's risk analysis (the complete analysis is presented as part II of the Supplemental Information accompanying this notice).

First, the Agency considered the various definitions of impairment used in the risk analyses in the literature. Three definitions of impairment have been widely recognized within the scientific community as useful for the purposes of assessing risk. All three focus on the risks of acquiring a 25 dB hearing ''level''—the deviation from audiometric zero. The three accepted approaches differ in that they examine hearing acuity at a different set of frequencies. For the purpose of its analysis, MSHA chose the approach that measures hearing acuity at those frequencies most relevant to the ability to understand human speech. This is the approach developed in 1972 by the National Institute for Occupational Safety and Health (NIOSH) and subsequently used by the Occupational Safety and Health Administration

(OSHA): a 25 dB hearing level at 1000, 2000 and 3000 Hz. The Agency is aware that NIOSH is now considering a revised approach that would include hearing acuity at 4000 Hz, but believes it is inappropriate to utilize that approach until peer review has validated its utility.

Next, the Agency reviewed the major studies on the level of risk at different noise exposures. The data consistently indicate that the risk of developing a material impairment of hearing, as a result of a working lifetime of occupational exposure, becomes significant when workplace noise exposures exceed an eight-hour time-weighted average (TWA_8) of 85 dBA. The table entitled ''Excess Risk Estimates'' presents estimates by NIOSH of how the excess risk of developing a material impairment (using its 1972 definition) varies with exposure over a working lifetime.

EXCESS RISK ESTIMATES

Exposure (TWA_8)	<80	80–84.9	85–89.9	90–94.9	95–99.9	≥100
Excess Risk	0	3%	15%	29%	43%	54%

MSHA also reviewed a large body of data on the effects of varying industrial noise exposures on worker hearing. These studies are supportive of the same conclusion. MSHA refined its picture of what occurs at lower sound levels by reviewing a number of other studies, particularly those of workers in other countries.

To confirm the magnitude of the risks of NIHL among miners, MSHA asked NIOSH to examine a body of audiometric data collected over the years tracking hearing acuity among coal miners. The analysis (Franks, 1996) supports the data from the risk studies. It indicates that 90% of these miners have a hearing impairment by age 50 as compared with only 10% of the general population. Further, Franks stated that miners, after working 20 to 30 years, could find themselves in life-threatening situations because safety signals and ''roof talk'' could go unheard. (For the purposes of the analysis, NIOSH used a definition of hearing impairment including losses at 4000 Hz; MSHA conducted its own analysis of the data without the 4000 Hz, and the results are generally consistent with those of NIOSH).

MSHA also examined other sources of data that might provide direct confirmation of the risks of hearing loss to miners—comments received in response to the Agency's Advance Notice of Proposed Rulemaking (ANPRM), (December 4, 1989, 54 FR 50209), the reports of hearing loss provided to the Agency by mine operators pursuant to 30 CFR part 50, and workers' compensation data. In each case, the available data are too limited to draw any conclusions. The Agency is requesting the public to provide further information along these lines.

To develop a profile of the mining population at risk, MSHA began by gathering information on noise exposures in the U.S. mining industry.

Current exposures appear to be gradually declining in the metal and nonmetal industry, where engineering or administrative controls are the primary means of miner protection against NIHL. But the data indicate that all sectors of the mining industry continue to have a significant number of overexposures.

Charts II–9 and II–10 display exposure trends based on inspector samples. Only those samples that exceed the PEL are displayed. For 1995, 14.4% of samples from the metal and nonmetal mining industry, and 22.5% of samples from the coal industry, exceeded the PEL. (Because they are 3–D graphs, the data points sometimes look lower than they are; the actual data points can be found in part II, Tables II–9 and II–10.)

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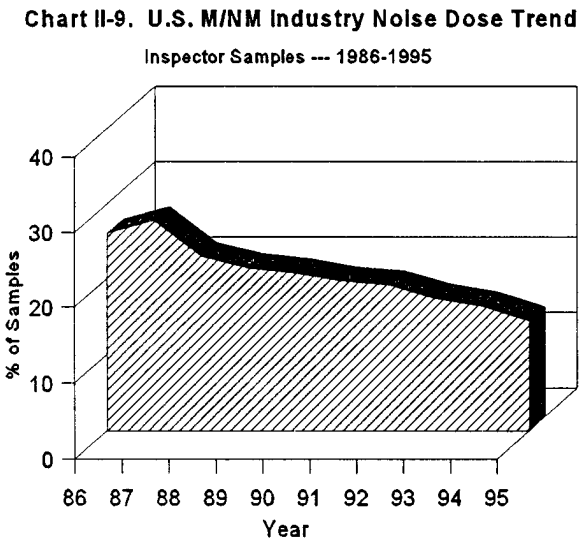

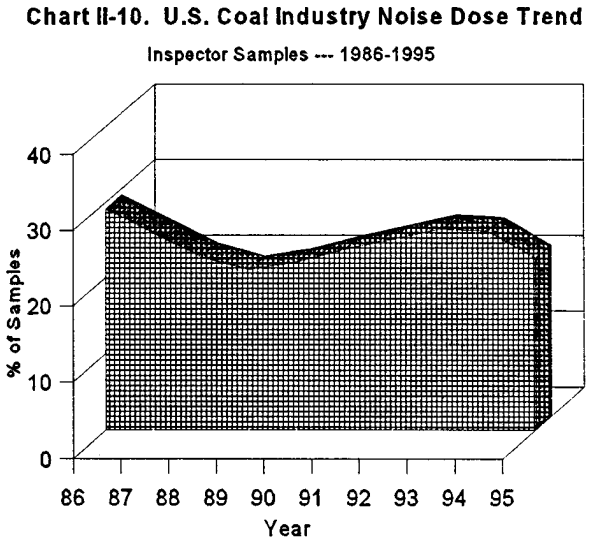

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These figures actually understate truly harmful exposures because the samples were taken in a way that did not count any exposures to sound levels below 90 dBA. As discussed herein (see Question 9), MSHA has concluded that exposures to sound levels above 80 dBA are harmful. Accordingly, to get a better picture of present harmful miner exposures, MSHA examined the results of a special survey taking thousands of

samples that included sound levels as low as 80 dBA. The results indicate that 36.8% of coal samples, and 26.9% of the metal and nonmetal samples would exceed the PEL if the lower, but still harmful, sound levels are counted in the dose measurement.

To derive a risk profile of miners, the Agency utilized the exposure data from the survey and the excess risk estimates. (The methodology for developing the miner risk profile is explained in detail in the Agency's preliminary RIA. Among other adjustments to the sample data, MSHA assumed coal miners were currently receiving some protection from hearing protectors; as a result, the estimates of miners at excess risk are lower than might be suggested by the foregoing figures.) Based on its analysis, MSHA estimates that 14% of U.S. miners—about 46,000 miners—can be expected under current exposure conditions to develop a material impairment of hearing of handicapping or disabling proportions during a working lifetime. The figures are 15% (19,000) of U.S. coal miners as a group and 13% (27,000) of U.S. metal and nonmetal miners.

The Agency is interested in receiving additional data with respect to the risks of noise exposure to workers and to the mining population in particular, as well as comments on its risk methodology and analysis.

(6) Why Proceed Without Waiting for NIOSH To Issue a New Criteria Document on Noise Exposure?

As MSHA was preparing this notice for publication, the National Institute for Occupational Safety and Health (NIOSH) released for peer review a draft criteria document for occupational noise exposure to update the one issued in 1972.

A summary of that draft, prepared and released by NIOSH, is included in the discussion of the rulemaking history in the Supplementary Information accompanying this notice. NIOSH is considering whether the evidence on noise since 1972 warrants a change in its recommendations. In some cases NIOSH is considering reiterating its prior recommendations, and in other cases it is considering changing its recommendations.

MSHA has determined that it would not be appropriate to delay publication of this proposed rule to await the possible issuance of a new NIOSH criteria document. The NIOSH draft is still being peer reviewed, and MSHA does not believe it would be appropriate to delay acting based upon the uncertain timing of the document's redrafting and release. Moreover, many of the issues covered in the NIOSH draft have been considered by MSHA, as part of the Agency's review of all the latest scientific information on noise.

Should a new criteria document be issued before MSHA promulgates a final rule, it will of course consider the NIOSH recommendations. The summary of the NIOSH draft included in this notice should provide ample notice to the mining community of the position NIOSH may take in a new criteria document.

(7) What Mines Are Covered by the Proposal?

The proposal would apply one set of rules uniformly to all mines. Those who responded to MSHA's ANPRM generally agreed that consolidation and simplification of multiple standards into one rule may help to facilitate understanding of, and thus compliance with, the regulatory requirements for controlling noise exposures.

(8) Are There Special Definitions Applicable?

To help mine operators and miners, the proposed rule would include definitions of some technical terms universally used in noise measurement. But the proposed rule also includes some terms used in a way that differs from usage in certain other contexts—e.g., under the OSHA standard.

In particular, MSHA is proposing a non-standard use of the term ''hearing conservation program'' or ''HCP.'' Most hearing conservation programs include provision for hearing examinations, training and the use of hearing protectors. Since audiograms would be new for the mining industry, unlike the other components, the Agency thought it might be less confusing to treat the components separately. Accordingly, under the MSHA proposal, hearing protector and training requirements are established independently, and a ''hearing conservation program'' is defined as a generic reference to those sections of the proposal that set forth the requirements for an audiometric testing program.

(9) How Is a Miner's Noise Dose To Be Determined Under the Proposal?

The proposal sets forth a formula for dose computation, which is to be measured over a full shift, which corresponds to the readouts of most currently used personal noise dosimeters.

The proposal would continue the use of a 5-dB exchange rate. The exchange rate is a measure of how quickly the dose of noise doubles. Accordingly, the measure is the rate determining how much a miner's exposure must be limited to compensate for increasing dose. Using the 5–dB exchange rate, the exposure time permitted at a sound level of 90 dBA is half that permitted at a sound level of 85 dBA—a miner gets the same noise dose in 4 hours at 90 dBA as at 8 hours at 85 dBA.

The Agency gave serious consideration to changing the exchange rate from 5 dB to 3 dB, and is specifically seeking comment on this important matter. There is a consensus in the recent literature that noise dose actually doubles more quickly than measured by the 5-dB rate; the consensus is for an exchange rate of 3 dB. Moreover, the current 5–dB exchange rate incorporates an assumption that there is significant time for hearing to recover from high sound levels. MSHA has concluded that noise exposure under mining conditions does not warrant such an assumption. A 3–dB exchange rate does not incorporate this assumption.

Nevertheless, the Agency is proposing to retain the existing 5-dB exchange rate because of feasibility considerations. Changing to a 3-dB rate from a 5-dB rate would significantly reduce the amount of time that miners could be exposed to higher sound levels without exceeding the PEL. For example, MSHA estimates that the percentage of miners whose exposure would be in violation of the PEL would just about double if a 3-dB exchange rate is used. This means mine operators would have to utilize controls to reduce exposures to the PEL much more frequently. Moreover, more expensive controls would often be required; if doses are doubling more quickly, the controls needed to reduce overexposures to the PEL would have to be more effective. Furthermore, if a 3-dB exchange rate is used, it is extremely difficult to reduce the noise exposures to the PEL with currently available engineering or administrative noise controls or a combination thereof. Accordingly, moving the industry to a 3-dB exchange rate may not be feasible at this time.

The sound levels to be included in a miner's dose are being expanded. At present, only exposures to sounds of 90 dBA and above are included in determining a miner's dose under MSHA's standards. (Thus, 90 dBA is considered the ''threshold.'') The proposed rule would include exposure to sound levels as low as 80 dBA. The Agency has concluded that capturing such sound levels is necessary if it establishes an action level based on an eight-hour time-weighted average of 85 dBA. Among other reasons, exposure of a miner to an extended shift (e.g.,16

hours) at just over 80 dBA can result in an exposure that exceeds the action level. OSHA uses this threshold for its action level, but a higher threshold for the PEL; based on the comments received in response to its Advance Notice of Proposed Rulemaking, MSHA concluded it would be easier for the mining industry to use a single threshold for both purposes.

While necessary, this change will generally result in higher dose readings in both the coal and metal and nonmetal sectors than at present. (See the discussion of exposure data in response to Question 5). In this case, however, MSHA has concluded that this change would clearly be feasible for the industry.

The proposed regulation would not allow dose measurements to be adjusted to reflect the effect of hearing protectors. This provision would reinforce MSHA's intent to preclude the current practice in the coal mining industry of not issuing a citation based upon a noise exposure that exceeds the PEL when the miners are wearing hearing protection. (See Question 11 for additional information on this topic.)

(10) What Controls Are Required Whenever a Miner's Exposure Exceeds the Action Level?

The proposal would require that all miners exposed above the action level be provided special instruction in the hazards of noise and protective methods. The training is to be provided annually for as long as exposure exceeds the action level. (The nature of this instruction, how it is to be provided, and how it can be coordinated with other required miner training are discussed in response to other questions.)

(11) What Additional Controls Are Required If a Miner's Exposure Exceeds the Action Level but Is Below the PEL?

An operator will be required to enroll a miner whose exposure exceeds the action level in a hearing conservation program (HCP). While enrollment in the HCP would require the operator to make annual audiometric testing available to the miner, miners exposed to noise below the PEL would have the right to decline taking any annual audiometric testing. The requirements for such testing are discussed in more detail in response to other questions.

MSHA is seeking comments on how to minimize the burden on mine operators of providing audiometric examinations for those miners with only a temporary attachment to the mining work force (e.g., summer employees), while recognizing the importance of detecting and tracking hearing loss among those who switch jobs.

In addition, the operator must provide properly fitted hearing protection in 3 cases: before the initial hearing examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon miner request.

Both MSHA and OSHA normally require an employer or operator to ensure that personal protective equipment is in fact used; an operator can be cited for failure to enforce rules to this effect. In the case of this proposal, however, MSHA is making two exceptions in that regard. First, should the initial hearing examination take less than 6 months to provide, the operator will not be required to ensure the provided hearing protection be worn. The operator is obligated to ensure protector use if more time is needed for the baseline examination (e.g., to wait for a mobile test van). Second, hearing protection provided because of miner request does not generate an operator obligation to enforce the use of the requested protection. At exposure levels above the action level but below the PEL, the proposal's goal is to encourage the use of hearing protection by training, providing choice, and encouraging proper fit—but the proposal would not require hearing protector use unless the miner has a significant threshold shift or unless the miner has to wait more than 6 months for a baseline examination.

(12) What Controls Are Required If a Miner's Exposure Exceeds the PEL?

If a miner's noise dose exceeds the PEL, the proposal would require the mine operator to use all feasible engineering and administrative controls to reduce the miner's noise exposure to that level. The mine operator has a choice of whether to use engineering controls, administrative controls, or both; but if administrative controls are utilized, a copy of the procedures involved must be posted, and copies given to the affected miners.

Under the proposal, a consistent hierarchy of controls is established for all mines. Mine operators must first utilize all feasible engineering and administrative controls to reduce sound levels to the PEL before (as explained in response to question 15) relying on other controls to protect against hearing loss. This approach is consistent with that currently in place for metal and nonmetal mines, but would be a change for coal mines. In the coal mining industry, MSHA inspectors do not cite for noise overexposures without first deducting from the measured dose the attenuating value of hearing protectors being worn by the miners exposed to excessive levels of noise. In practice, this means that personal protective equipment is in most cases accepted as a substitute for engineering and administrative controls.

MSHA has conducted research on the attenuating value of hearing protectors under actual mining conditions and has reviewed the literature on this issue. MSHA is aware that NIOSH is considering new approaches on how to establish a system that will accurately derate hearing protector attenuation values for actual workplace conditions; but the Agency's own research suggests that the attenuation of a hearing protector is highly variable in practice, and that the amount of attenuation cannot be predicted accurately. This is discussed in part III of the Supplementary Information accompanying this notice.

MSHA has also considered the data showing declining noise exposures in the metal and nonmetal industry, and contrasted this with the data on the coal mining industry.

The Agency has concluded that, in practice, reliance upon hearing protectors to reduce noise exposures simply does not provide effective protection against hearing loss to miners. The Agency does not contend that properly fitted and maintained hearing protectors are worthless; on the contrary, the Agency is proposing to rely upon them as a supplemental control, and has taken their value into account in conducting its risk and benefit analyses. MSHA has concluded, however, that hearing protectors should no longer be relied upon as a primary means of control, and that this change can bring about dramatic reductions in the rate at which coal miners would otherwise be expected to incur hearing impairments.

(13) For an Individual Mine Operator, What Are ''Feasible'' Engineering and Administrative Controls?

The proposal would require a mine operator to use only such engineering controls as are technologically feasible, and to use only such engineering and administrative controls as are economically feasible for that mine operator. Those in the metal and nonmetal mining industry are already familiar with the Agency's policies and practices in this regard, but those in the coal mining industry may wish to take note of the following few paragraphs.

The Federal Mine Safety and Health Review Commission (Commission) has addressed the issue of what MSHA must consider, with regard to MSHA's existing noise standard for metal and

nonmetal mines, when determining what is a feasible noise control for enforcement purposes at a particular mine. According to the Commission, a control is considered feasible when: (1) The control reduces exposure, (2) the control is economically achievable, and (3) the control is technologically achievable. See *Secretary of Labor* v. *Callanan Industries, Inc.*, 5 FMSHRC 1900 (1983), and *Secretary of Labor* v. *A. H. Smith*, 6 FMSHRC 199 (1984).

In determining technological feasibility of a proposed control, the Commission has ruled that a control is deemed achievable if through reasonable application of existing products, devices, or work methods with human skills and abilities, a workable engineering control can be applied to the noise source. The control does not have to be ''off-the-shelf;'' but, it must have a realistic basis in present technical capabilities.

In determining economic feasibility, the Commission has ruled that MSHA must assess whether the costs of the control are disproportionate to the ''expected benefits'', and whether the costs are so great that it is irrational to require its use to achieve those results. The Commission has expressly stated that cost-benefit analysis is unnecessary in order to determine whether a noise control is required. According to the Commission, an engineering control may be feasible even though it fails to reduce exposure to permissible levels contained in the standard, as long as there is a significant reduction in exposure. *Todilto Exploration and Development Corporation* v. *Secretary of Labor*, 5 FMSHRC 1894 (1983). No guidance has been provided by the Commission as to what level of reduction is considered significant. However, the Commission has accepted the Agency's determination that a 3 dBA reduction is significant.

In the metal and nonmetal mining industry, MSHA has interpreted the ''expected benefits'' to be the amount of noise reduction achievable by the control. MSHA generally considers a reduction of 3 dBA or more to be a significant reduction of the sound level. Consequently, a control that achieves relatively little noise reduction at a high cost could be viewed as not meeting the Commission's test of economic feasibility.

Accordingly, consistent with the case law, MSHA has considered three factors in determining whether engineering controls are feasible at a particular metal and nonmetal mine: first, the nature and extent of the overexposure; second, the demonstrated effectiveness of available technology; and third, whether the committed resources are wholly out of proportion to the expected results. Before a violation of these requirements of the standard could be found, MSHA would have to determine that a worker has been overexposed; that administrative or engineering controls are feasible; and that the mine operator failed to install or maintain such controls.

Part III of the Supplemental Information accompanying this notice provides many examples of engineering controls that are feasible for mine operators to utilize, and the Agency and the former Bureau of Mines (USBOM) have available many other materials in this regard. Nevertheless, the Agency welcomes information about particular operations for which it may be particularly difficult to control noise.

(14) Is It feasible for the Coal Mining Industry, and for the Metal and Nonmetal Mining Industry, To Provide the Controls Proposed To Be Required When Noise Exposures Exceed the PEL?

Part IV of the Supplementary Information in this notice provides a detailed discussion of the statute's requirements and the Agency's analysis in this regard. The Agency has concluded that the coal mining industry as a whole, and the metal and nonmetal mining industry as a whole, can meet these requirements at a PEL set at a TWA_8 of 90 dBA.

In fact, the Agency seriously considered lowering the PEL. As noted in response to Question 5, MSHA has concluded that there is a significant risk of material impairment from noise exposures at or above a TWA_8 of 85 dBA. MSHA believes, however, that such a change may not be feasible at this time for the mining industry. Based on an analysis of exposure survey data, MSHA has concluded that if the PEL were a TWA_8 of 85 dBA, about two-thirds of the mine operators in the metal and nonmetal mining industry, and about three-quarters of the mine operators in the coal mining industry, would need to use engineering and administrative controls to reduce current exposures. Moreover, the engineering controls needed to reduce those exposures would be more expensive, because they would have to be capable of reducing the exposures further than with a PEL set at a TWA_8 of 90 dBA.

(15) What Supplemental Controls Are Required If a Miner's Exposure Cannot Be Feasibly Reduced to the PEL?

If reducing the dose to this level with such controls is not feasible, the proposal requires the mine operator to use such controls to lower the noise exposure as much as is feasible.

In addition, in such cases, the proposal requires that the operator take extra steps to protect miner hearing. The operator must ensure any miner so exposed takes the annual hearing examinations, must provide properly fitted hearing protection to all miners so exposed, and must ensure the hearing protection is used by all miners so exposed.

MSHA believes that when a miner is exposed to such high levels of noise because engineering and administrative controls are not feasible for an operator, these supplemental obligations are necessary to protect miner hearing. Hearing protectors are not without their discomforts, but the risk of hearing loss at such exposure levels ought to be a controlling factor. While audiometric testing is not an invasive procedure, the Agency is concerned that there may be economic pressures and personal reasons that may lead miners to decline to take hearing examinations. The information generated by these tests is necessary, however, to trigger investigation of potentially serious flaws in the layers of noise controls required at these high exposure levels. In addition, the Agency believes that miners operating under such high noise conditions should be aware of the severity of any hearing loss; in a mining environment, this knowledge could have implications for the safety of the miner and the safety of others. Comments on this provision are specifically solicited.

(16) Is There an Absolute Maximum Noise Dose?

Under the proposal, a miner, as at present, is never to be exposed to sound levels exceeding 115 dBA. This is because sound at that level provides the full dose permitted in a matter of minutes.

There is, however, no dose which the Agency would require to be abated without regard to whether it is feasible for an individual mine operator. The proposal does provide that should a miner's noise exposure exceed a TWA_8 of 105 dBA during any workshift, the mine operator shall, in addition to taking all actions required to protect miners exposed above the PEL, also require the miner to use dual hearing protection, i.e., both a plug type and a muff type hearing protector. A TWA_8 of 105 dBA is a dose of 800% of the PEL, using a 5-dB exchange rate. In the notice accompanying this proposal, the Agency presents information about the mining jobs at which the exposures of this level are occurring, and requests comment on

whether there should be an absolute dose ceiling regardless of the feasibility of control by an individual mine operator.

(17) What Are an Operator's Obligations Under the Proposal To Monitor Noise Exposures?

The proposal would require mine operators to establish a system of monitoring which effectively evaluates each miner's noise exposure. This will ensure that mine operators have the means to determine whether a miner's exposure exceeds any of the limitations established by this section, as well as to assess the effectiveness of noise controls. The proposed rule is performance oriented in that the regularity and methodology used to make this evaluation are not specified; MSHA's own measurements will enable it to check on the effectiveness of an operator's monitoring program. Specific requirements for biannual noise surveys, monitoring records, supplemental noise surveys, calibration reports, survey reports, and survey certifications now applicable to the coal sector would be revoked, significantly reducing cost and paperwork burdens.

(18) When Must Miners Be Notified of Monitoring Results?

The proposal would require that miners be notified in writing should their exposure exceed any of the levels specified by this section—whether based on operator or MSHA evaluations of noise. Notice would be required within 15 calendar days.

The proposal has been designed to ensure that miners are made aware of the hazards they currently face. Miners exposed above the action level should be notified of that fact so, for example, they can consider the importance of using provided, properly fitted and maintained hearing protectors. On the other hand, the proposal does not require notification of a particular miner if an exposure measurement indicates that the miner's exposure has not changed and the miner has within the last year been apprised of the same information. No notification is required if a miner's measurement is below the action level—although operators might wish to provide such notification if this indicates a reduction in noise exposure.

(19) What Rules Are There To Ensure That Required Hearing Protectors Provide Effective Protection?

Whenever hearing protectors are to be provided, they must be provided in accordance with specific requirements. The miner is to have a choice from at least one earplug type and muff type protector; and, in the event dual hearing protection is required, a choice of one of each. Whenever the mine operator is required to ensure that hearing protection is worn (the circumstances are noted in response to prior questions), it is worn by the miner when exposed to sound levels required to be integrated into a miner's dose measurement, i.e., any sound levels above 80 dBA. The hearing protector is to be fitted and maintained in accordance with the manufacturer's instructions. Hearing protectors and necessary replacements are to be provided at no cost to the miner. Finally, should the miner suffer a medical pathology of the ear, the miner is to be allowed to select a different hearing protector from among those offered by the mine operator.

MSHA has concluded that existing rating systems for hearing protectors do not provide a reliable measure of effectiveness under normal mining working conditions. The Agency believes that the best way to ensure such devices can provide effective protection is to focus on the conditions affecting hearing protector use.

(20) How Frequently Must Required Training Be Provided?

If a miner's noise exposure exceeds the action level, training is to be provided annually. The training is to be provided when the miner is first determined to have exceeded the action level and every 12 months thereafter that the miner continues to exceed that level.

Annual refresher training is necessary to reinforce the proper procedures for the use and care of hearing protectors, and the importance of administrative and engineering controls. Additionally, it serves to re-emphasize the hazards of noise and the purpose for audiometric testing for those miners exposed above the PEL. MSHA received comments in response to its Advance Notice of Proposed Rulemaking (ANPRM) that supported an annual training requirement. Studies have shown that the effectiveness of an HCP is highly dependent on the proper use of hearing protectors and the commitment of both management and the employees, both of which can be enhanced by training.

(21) What Specifications Are There With Respect to the Instruction To Be Provided During Required Training?

Miners would receive instruction in hearing protection: (1) the need for such protection, (2) selection and fitting, and (3) proper use of such protectors. Miners would also receive instruction about hearing conservation programs: as to the operation of that program and the mine operator's noise control efforts. There are no special qualifications for instructors, nor any specifications on the hours of instruction. Training is required to be provided without cost to the miner. The mine operator would be required to certify the completion of any training required by this part, and maintain the most recent certification for a miner at the mine site for as long as the miner is required to use hearing protectors or be enrolled in an HCP, and at least 6 months thereafter.

(22) Can the Required Training Be Covered During Part 48 Training?

Yes, but it may not always be feasible to do so.

MSHA considered whether the requirements of part 48, ''Training and Retraining of Miners,'' were adequate to ensure the training required under this part. The requirements of part 48 specify the initial and annual retraining of all miners in a list of subjects, many specified in the law itself (section 115 of the Mine Safety and Health Act). The importance of this training is emphasized by statutory requirements for the submittal of training plans, on the specification of the hours to be devoted to the training, and on the qualifications of instructors. Training is required on noise, but it is in general terms, covering the purpose of taking exposure measurements and on any health control plan in effect at the mine. Mine operators may provide additional training, but the topics that need to be covered may make this impracticable within the prescribed time limits.

After considering the available information about the importance of training requirements, and based upon its experience in implementing the requirements of part 48, MSHA has determined that the requirements of part 48 do not provide adequate noise training for those miners for whom exposure is clearly a problem. Most current part 48 training is neither comprehensive enough to provide such miners with the level of education needed for the proper use of hearing protection devices, nor, in the case of noisy mines, detailed enough on methods to reduce sound levels.

Nevertheless, MSHA believes compliance with this proposal can in many cases be fulfilled at the same time as scheduled part 48 training. The Agency does not believe special language in proposed part 62 is required to permit this action under part 48, but welcomes comment in this regard. Mine operators who can do so are free to fulfill their noise training requirements by covering the topics in initial and

annual part 48 training, and may so certify on the separate form required by this part. If incorporated into part 48, mine operators would, however, be required to submit a revised training plan to the appropriate district office for approval. Some mine operators, however, may not be able to incorporate these topics in their part 48 plans. Moreover, it is important to note that there are some circumstances in which training required under the proposal will likely not fit within a regular schedule, e.g., the training required when a miner's exposure is determined to require selection of a hearing protector or a new protector.

MSHA has endeavored to make the training requirements as simple as possible. If conducted separately from part 48 training, there are no specifications on trainer qualifications, no minimal training time, nor any training plans. If, however, the training is incorporated into part 48, then all applicable part 48 requirements will have to be met.

(23) If a Mine Operator Is Required To Offer Audiometric Testing, When Must a Baseline Audiogram Be Taken?

It is critical to obtain a baseline audiogram before exposure to hazardous noise. If this is not possible, then the baseline is to be obtained as soon as is reasonably possible.

Due to remote locations and intermittent operations of many mines, MSHA determined that allowing six months (or 12 months if a mobile test van is used) for offering the baseline audiogram was reasonable. The 12 month period would allow mine operators to schedule many baseline and annual audiograms simultaneously, and thus, substantially reduce the cost when mobile test vans are used. Miners enrolled in a hearing conservation program would be provided hearing protection until such time as the baseline audiogram is conducted. In the case of a miner who has to wait more than 6 months for a baseline examination because of the need for a mobile test van, and in the case of a miner whose exposures cannot be reduced to the PEL through the use of all feasible engineering and administrative controls, the operator would be required to ensure the hearing protection is worn.

MSHA has also determined that a 14-hour quiet period should precede the baseline audiogram to ensure a valid result. Moreover, unlike the OSHA rule, MSHA's proposal would not permit the use of hearing protectors as a substitute for a quiet period. The Agency has determined this is necessary to ensure that a temporary threshold shift in hearing acuity does not occur during the quiet period, rendering the baseline audiogram inaccurate. Moreover, MSHA's research has not shown a reliable method for predicting hearing protector attenuation under actual working conditions. Under the proposal, miners are to be notified of the importance of compliance with the quiet period. MSHA is not proposing to require this quiet period for annual audiograms, although it may be in the mine operator's interest to do so.

(24) What Qualification Requirements Are Proposed for Those Who Will Take Audiograms?

MSHA would require that an ''audiologist'' be certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners. ''Qualified technicians'' would be required to have been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC) or another recognized organization offering equivalent certification. CAOHC or equivalent certification would assure that the technicians are qualified. MSHA is not proposing to require qualifications for physicians.

(25) Does the Proposal Specify Audiometric Test Procedures?

MSHA proposes not to include specific procedural requirements for conducting audiometric tests, calibrating audiometers, and qualifying audiometric test rooms. Instead, MSHA proposes a performance-oriented requirement that audiometric testing be conducted in accordance with scientifically validated procedures. MSHA would specify the test frequencies, but would allow the physician or the audiologist to use professional judgement in choosing the appropriate testing procedure(s) and require certification of the scientific validity of the procedures.

While this approach may require somewhat more in the way of paperwork requirements, MSHA believes this is far preferable to the alternative of a detailed specification standard, which could stifle technology and impede improvements in methodology.

(26) What Test Records Must Be Maintained?

The proposal would also specify what records must be maintained at the mine site and the retention duration. The proposed items included in the audiometric test record—name, job classification, audiograms and certifications as to the procedures used to take them, any exposure determinations, and the results of any follow-up examinations—would provide information essential for evaluating a miner's audiogram, among other purposes.

The proposal would require that the audiometric records be retained for at least six months beyond the duration of the miner's employment. The six-month retention period at the mine site would assure that test records are not destroyed during what might be normal breaks in employment and remain available for use by the mine operator to conduct further evaluations upon the miner's return. In practice, MSHA believes that many mine operators will keep a miner's audiograms long after the miner's employment ceases, for use if the miner should file a subsequent workers' compensation claim for hearing loss.

(27) How Are Audiograms To Be Evaluated?

MSHA's proposal would require that the mine operator inform the person evaluating the audiogram of the requirements of this part and provide such person with copies of the miner's audiometric test records. The mine operator would be responsible for having a physician, audiologist, or qualified technician determine if an audiogram is valid, and to determine if a standard threshold shift in hearing acuity (STS) or reportable hearing loss has occurred. Time frames within which these actions must occur are part of the proposal.

The proposal would permit, but not require, mine operators to adjust audiometric test results by applying a correction for presbycusis, the progressive loss of hearing acuity associated with the aging process, before determining whether an STS or reportable hearing loss has occurred, and it includes tables for this purpose. The proposed adjustment for presbycusis is optional, however, if a mine operator uses this approach, it must be applied uniformly to both the baseline and annual audiograms in accordance with the procedures and values listed in the proposed standard. Although this is the position taken in the proposal, MSHA notes that NIOSH recently has advised against the use of presbycusis correction factors. Moreover, the Agency is concerned about locking-in particular presbycusis adjustment tables. MSHA, therefore, requests additional comments on whether to use presbycusis corrections for audiograms and, if so, how to

provide for such adjustment in a regulatory context.

(28) What Happens If an Audiogram Is Not Valid?

A prompt retest is required.

When a valid audiogram cannot be obtained due to a suspected medical pathology of the ear, and the physician or audiologist evaluating the audiogram believes that the problem was caused or aggravated by the miner's exposure to noise or the wearing of hearing protectors, a miner must be referred for a clinical audiological or otological evaluation as appropriate at mine operator expense.

If the physician or audiologist concludes that the suspected medical pathology of the ear which prevents obtaining a valid audiogram is unrelated to the miner's exposure to noise or the wearing of hearing protectors, the miner is to be advised of the need for an otological evaluation; but in such cases, no financial obligation would be imposed on the mine operator.

A mine operator would be required to instruct the physician or audiologist not to reveal to the mine operator any specific findings or diagnoses unrelated to the miner's exposure to noise or the wearing of hearing protectors without the written consent of the miner.

(29) What Corrective Measures Are Required When a Standard Threshold Shift in Hearing Acuity (STS) Is Detected?

STS is defined in this proposal, as in OSHA's standard, as a change in a worker's hearing acuity for the worse, relative to that worker's baseline audiogram, of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

If the STS is determined to be permanent, a supplemental baseline is established and this becomes the baseline for determining any future STS. This definition is sufficiently restrictive to locate meaningful shifts in hearing, yet not so stringent as to create unnecessary follow-up procedures. The frequencies were chosen for this purpose to ensure hearing losses are detected as soon as feasible. While NIOSH is currently considering an approach that would not require averaging at several frequencies, this remains under peer review; moreover, the averaging of hearing levels at adjacent frequencies will reduce the effect of testing errors at single frequencies.

MSHA's proposal would require that, unless a physician or audiologist determines that an STS is neither work-related nor aggravated by occupational noise exposure, mine operators would have 30 days after the finding of an STS to—

(1) Retrain the miner;

(2) Provide the miner with the opportunity to select a hearing protector, or a different hearing protector if the miner has previously selected one; and

(3) Review the effectiveness of any engineering and administrative controls to identify and correct any deficiencies. The proposal also requires that an operator ensure that a miner with an STS wear the provided hearing protector.

A hearing loss of 10 dB from a miner's prior hearing level is of enough significance to warrant intervention by a mine operator, unless it is determined the loss is not work-related. If the controls in place are effective, including the training, this loss should not be occurring. It should be noted that the retraining required is to take place within 30 days after the finding of the STS, and thus it is unlikely mine operators can satisfy this requirement through their part 48 training programs.

MSHA's proposal does not include a provision for transferring a miner who incurs repeated STS's. A miner transfer program would be complex to administer, and would probably not be feasible in the metal and nonmetal sector. This sector consists largely of smaller mines which may be unable to feasibly rotate workers to other assignments on a long-term basis.

(30) When Must MSHA Be Notified About Hearing Loss?

Pursuant to 30 CFR part 50, MSHA must be notified of any ''reportable'' hearing loss. There is currently no uniform definition of this term. The proposed rule would establish a uniform definition for reporting a miner's hearing loss—a change in hearing acuity for the worse relative to the miner's baseline audiogram of an average of 25 dB or more at 2000, 3000, and 4000 Hz in either ear. MSHA intends that a loss for any miner need not be reported again until there is an additional 25 dB loss. Having a uniform definition will ease reporting burdens on mine operators while promoting the development of an improved data base on hearing loss in the mining community.

MSHA has two specific questions in this regard on which it is seeking comment. First, MSHA would like comment on how to define ''reportable'' hearing loss for those operators who do not have audiometric test data. Not all mine operators will be required to obtain audiometric test data under the proposed rule; thus, such operators may not be able to use a definition of reportable hearing loss defined in this manner.

Second, MSHA is concerned that reporting only losses of 25 dB may not provide MSHA a full picture of hearing loss in the mining industry. A loss of 25 dB is used by many states as a basis for making disability awards. Some have recommended that any STS (10 dB loss) should be captured in a hearing loss data base. OSHA, which currently requires any 25 dB loss to be captured in an employer's log, has proposed to capture any 15 dB loss. MSHA accordingly solicits comment on this point.

(31) When Must a Miner Be Notified of Audiometric Testing Results?

The proposal would require the mine operator, within 10 working days of receiving the results of an audiogram, or receiving the results of a follow-up evaluation, to notify the miner in writing of the results and interpretations, including any finding that an STS or reportable hearing loss has occurred. The notification would include an explanation of the need and reasons for any further testing or evaluation that may be required.

MSHA believes that informing miners of the results of their audiometric tests in a timely manner is critical to the success of an HCP. Immediate feedback upon completion of the testing provides the greatest benefit.

(32) Who Has Access to Exposure and Test Records Maintained by Mine Operators?

Authorized representatives of the Secretaries of Labor and Health and Human Services would have access to all records required under this part.

Moreover under the proposal, a miner or former miner, or his/her designated representative with written consent, would have access to all the records that the mine operator is required to maintain under this part for that individual miner or former miner. Also, the miners' representative is in all cases to have access, for miners they represent, to noise training records and to notices required to be made to miners exposed to noise above various levels.

The mine operator would have 15 days from receipt of a written request to provide such access. The proposal would define ''access'' as the right to examine and copy records. The first copy of any record requested by a person is to be provided without cost to that person, and any additional copies requested by that person are to be provided at reasonable cost.

Upon termination of employment, mine operators would be required to provide a miner, without cost, an actual copy of all his or her own records (those required under this part).

The proposed standard would require mine operators to transfer all records (or a copy thereof) required by this part to any successor mine operator. The successor mine operator would be required to receive these records and maintain them for the period required. Additionally, the successor mine operator would be required to use the baseline audiogram obtained from the original mine operator (or supplemental baseline audiogram as appropriate) for determining an STS and reportable hearing loss.

MSHA has no uniform records access provision. The provisions proposed here are similar to those in other health standards proposed in recent years by the Agency. The Agency welcomes comment on whether it needs to make changes to facilitate the use of electronic recordkeeping systems.

(33) How Does the Proposal Compare With the Existing Standards?

MSHA has prepared two charts comparing some of the key features of the proposed standard to MSHA's existing standards. A comparison to OSHA's noise standard is also provided since many mine operators and others are familiar with that standard.

It is important the reviewers exercise some caution in using these charts. The entries were ''shorthanded'' to fit into the chart. Accordingly, other parts of this preamble should be consulted for details. In comparing the proposed rule with OSHA's standard, for example, reviewers interested in differences on the definition of a hearing conservation program should consult the answer to Question 8; those interested in differences on the threshold should consult the answer to Question 9; those interested in differences on employer obligations to ensure the wearing of provided hearing protections should consult the answer to Question 11; and those interested in differences about the use of hearing protection in lieu of a quiet period before a baseline audiogram should consult the answer to Question 23.

Care should also be taken in consulting the existing standards themselves. The entries in the charts and the discussions in the preamble reflect legal and/or policy interpretations of the various standards that now determine their meaning, something that would not be apparent from an examination of the text of the standards.

To conserve space, the following abbreviations are used in the charts: HP (hearing protection), HCP (hearing conservation program), STS (standard threshold shift), TWA_8 (time-weighted eight-hour average), dBA (decibel, A-weighted), PEL (permissible exposure limit); ''admin'' (administrative), kHz (kilohertz), and N/A (none or not applicable).

COMPARISON CHART 1: EXPOSURE/DOSE TRIGGERS

TWA_8 noise above	Proposal	Existing metal/nonmetal	Existing coal	OSHA
85 dBA	Provide training on noise; enroll miner in HCP (must offer annual hearing test); provide HP before baseline audiogram taken, if STS detected or upon request of miner; must ensure miner uses HP if more than 6 months for baseline (mobile van) or STS detected.	No action required	No action required	Enroll employee in HCP (must offer annual hearing test); if more than 6 months before baseline audiogram taken (mobile van), employee must be provided and wear HP; employee must also be provided and use HP if STS detected.
90 dBA	Use all feasible engineering and admin. controls to reach; if can't reach 90 using such controls, use controls to get as low as possible, provide HP to all miners, ensure HP used and ensure hearing tests taken.	Use all feasible engineering or admin. controls to reach; if can't reach 90 using such controls, then must also provide HP.	Use all feasible engineering or admin. controls to reach * * * but can first reduce exposure reading by rated value of HP minus 7 unless cited for failure to require HP use; must enroll miners in HCP if cited.	Use all feasible engineering or admin. controls to reach * * * but if exposure less than 100 dBA, can first reduce reading by value of HP attenuation =.50 x (rated value of HP minus 7).
105 dBA	Dual HP must be provided and used.	Limited requirement for dual HP.	n/a	n/a.

COMPARISON CHART 2: ISSUES

Issue	Proposal	Existing metal/nonmetal	Existing coal	OSHA
Monitoring	Operator must establish system of monitoring exposures.	No requirement on mine operator.	Mine operator required to conduct periodic monitoring.	Employer must conduct represent. personal sampling if info suggests noise exceeds action level.
Notification of exposure level.	Notify miner of measured exposure level if: (a) exposure changed, or (b) even if shows no change if miner not notified within last year.	Not required	Not required	Notify employee if exposure exceeds action level.

COMPARISON CHART 2: ISSUES—Continued

Issue	Proposal	Existing metal/nonmetal	Existing coal	OSHA
Threshold: lowest sound levels counted.	80 dBA	90 dBA	90 dBA	80 dBA for monitoring & HCP enrollment but 90 dBA for PEL.
Exchange rate	5 dB	5 dB	5 dB	5 dB.
Ceiling	115 dBA	115 dBA	115 dBA	115 dBA.
Training on hearing protector selection & use.	Annual if above action level.	Part 48 general discussion	Part 48 general discussion	Annual if exposure exceeds TWA_8 of 85 dBA.
Training on audiology & employer program.	Annual if above action level.	No	No	Audiology only; annual if enrolled in HCP.
Quiet period before aud. exam.	14 hours for baseline audiogram; can not use hearing protectors.	n/a	n/a	14 hours for baseline audiogram; can use hearing protectors.
Standard threshold shift	10 dB av. shift @ 2, 3, & 4 KHz.	n/a	n/a	10 dB av. shift @ 2, 3, & 4 KHz.
Reportable hearing loss	Must report 25 dB av. shift @ 2, 3, & 4 kHz, either ear.	Reporting required but level not defined.	Reporting required but level not defined.	No reporting; must record 25 dB av. shift @ 2, 3, & 4 kHz, either ear; 1/96 proposal would drop to 15 dB.
Employee access to records.	Yes	No	No	Yes.

(34) Is MSHA Going To Write the Final Rule in Plain English so Miners and Mine Operators Can Understand Their Obligations?

The text of the proposed rule can be found at the very end of this notice. While the Agency endeavored to write clearly, it is interested in suggestions to make the final rule as comprehensible as possible to mine operators and miners.

MSHA has developed two examples, based on the proposed rule, to illustrate some alternative approaches it could take.

The first example illustrates one way in which a rule's organization can be reformulated so as to serve as a more useful reference tool. This proposal's table of contents begins as follows:

62.100 Purpose and scope; effective date.
62.110 Definitions
62.120 Limitations on noise exposure

The alternative version presents the table of contents as a series of practical questions that are likely to be asked by the mining community. The sections have been subdivided so as to address questions one at a time. In the mining industry, the Department of the Interior has also experimented with this approach, e.g., proposed coalbed methane regulations (60 FR 47920).

62.100 What is the purpose of requiring mine operators to limit miner noise exposure?
62.101 What kinds of mining operations are covered by this regulation?
62.102 When does this regulation take effect?
62.110 What is meant by various technical terms used in this regulation?
62.120 How is a miner's noise dose calculated?
62.121 How is dose converted to 8-hour time-weighted averages?
62.122 Can a miner's dose measurement be adjusted to reflect the type of hearing protection being worn by the miner?
62.123 What are a mine operator's obligations to evaluate miner noise exposure?
62.124 When must miners and/or their representatives be notified of measured exposures?
62.130 What must a mine operator do whenever a miner's noise dose exceeds the action level?
62.131 What else must a mine operator do if a miner's noise dose exceeds the action level but remains below the PEL?
62.132 What else must a mine operator do if a miner's noise dose exceeds the PEL?
62.133 What is the highest sound level to which a miner may be lawfully exposed?

The contents of several of these sections might be more clear if presented in a tabular format. This would be particularly useful where the mine operator may have choices or has to do more than one thing. An example involves the controls required at the action level. The current proposal, as it would appear in the Code of Federal Regulations, as paragraph (b) of proposed § 62.120, is:

(b) *Action level.* When a miner's noise exposure exceeds a TWA_8 of 85 dBA during any workshift, or equivalently a dose of 50%, the operator shall take the actions specified in paragraphs (b) (1) and (2) of this section and, at the request of the miner, also take the actions specified in paragraph (b)(3) of this section.

(1) An operator shall provide the miner training that includes the instruction required by § 62.130, at the time exposure exceeds the action level and every 12 months thereafter that exposure continues to exceed the action level.

(2) An operator shall enroll the miner in a hearing conservation program which shall meet the requirements of §§ 62.140 through 62.190. Moreover, the operator shall, with respect to any miner enrolled in such program, provide hearing protection in accordance with the requirements of § 62.125 until such time as a baseline audiogram has been obtained. If it takes more than 6 months to conduct the baseline audiogram, or if the miner is determined to have incurred an STS, the operator shall ensure that the hearing protection is provided to the miner and worn by the miner.

(3) At the request of any miner, the operator shall provide hearing protection to the miner in accordance with the requirements of § 62.125.

The alternative format would appear, using the revised numbering and naming conventions from example 1, somewhat like the following:

62.131 What specifically must a mine operator do if a miner's noise dose exceeds the action level?

If a miner's noise exposure exceeds a dose of 50% (a TWA_8 of 85 dBA):

You must	Which means you
(a) Provide training.	Provide a miner with the training required by MSHA's rules— (1) When his or her exposure exceeds the action level; and (2) Every 12 months thereafter that his or her exposure continues to exceed the action level.

You must	Which means you
(b) Enroll the miner in a hearing conservation program.	(1) Offer the miner annual audiometric examinations that comply with MSHA's rules for hearing conservation programs; and (2) Provide a miner with hearing protection until a baseline audiogram has been taken; and in the event that will take more than 6 months due to the needs to wait for a mobile test van, require the miner to use the hearing protector; and (3) Provide a miner with hearing protection, and require its use, whenever an STS is detected.
(c) At the request of a miner, provide the miner with hearing protection.	Provide hearing protection in accordance with MSHA's rules.

MSHA's rules for training are discussed in § 62.137. MSHA's rules for hearing conservation programs are discussed in §§ 62.140 through 62.190. MSHA's rules for hearing protection are discussed in § 62.135.

MSHA has not yet consulted with the Office of the Federal Register on the specifics of such approaches; moreover, the examples noted above should not be considered as necessarily accurately representing the content of MSHA's proposed rule. These caveats notwithstanding, the Agency is interested in the potential of these approaches, and would welcome comment on these specific examples.

(35) Is MSHA Going To Provide Adequate Guidance Before Implementing the Rule?

The Agency plans to take several steps toward this end.

First, the Agency is proposing that the new standard not take effect until one year after the date of publication of the final rule. This should provide time to train MSHA personnel and provide mine operators with technical assistance and guidance. An alternative would be to phase in the new requirements. The Agency believes some could be phased in quickly, but wants to avoid confusion. The Agency requests comment on whether a phased-in approach is appropriate and how it might most effectively be designed.

In addition, the Agency is committed to issuing a compliance guide for mine operators before a final rule takes effect. MSHA would welcome suggestions on matters that should be discussed in such a guide.

MSHA would also welcome comments on other actions it could take to facilitate implementation, and in particular whether a series of workshops would be useful.

(36) Are There Special Enforcement Issues of Which the Mining Community Should Take Note?

Question 13 addresses the question of what constitutes ''feasible'' engineering and administrative controls.

Operators in the mining industry are aware that the Agency has traditionally not cited an operator for exceeding the PEL unless the Agency's measurement of noise shows that it exceeds a TWA_8 of 92 dBA. This provides adequate room to accommodate, in an enforcement context, any technical questions about MSHA's measurements. MSHA's citation policy does not, however, alter operator obligations of the rule, including those based on operator exposure readings.

The Agency is interested in comment on whether the new final rule should include a provision requiring operators to develop a written plan in certain cases. At the present time, coal operators in violation of the PEL must submit for approval a plan for the administration of a continuing, effective program to assure compliance including provision for reducing environmental noise levels, hearing protectors, and audiograms. No such plans are provided in the metal and nonmetal sector. The proposed rule, which would establish a uniform approach to noise for both sectors, would eliminate the current coal requirement, because MSHA does not believe such plans need to be created every time an operator violates the PEL. The Agency recognizes, however, that achieving effective compliance in some cases would be furthered by the existence of a written plan. In particular, such plans may be appropriate when there is a history of multiple noise violations, or a failure to effectively abate. Such plans would include specific details on how operators will comply with the final rule; a failure to comply with the plan's specifications would be enforceable through MSHA's normal citation/order process. Making explicit provision in the standard for such plans would ensure clarity about the Agency's enforcement policy on noise.

The Agency notes that in some cases the proposal would require operators to ensure certain miners wear hearing protection that is provided, and ensure certain miners take tests that are offered. Comment is welcome on how Agency personnel could distinguish these miners from others.

(B) Executive Order 12866

In accordance with Executive Order 12866, MSHA has prepared a preliminary analysis of the estimated costs and benefits associated with the proposed revisions of the noise standards for coal and metal and nonmetal mines.

The preliminary RIA containing this analysis is available from MSHA. MSHA welcomes comments on its analysis and methodology. The proposal would cost approximately $8.3 million and would save 765 hearing impairment cases annually. The benefits are expressed in terms of cases of hearing impairment that can be avoided and have not been monetized. Although the Agency has attempted to quantify the benefits, it believes that monetization of these benefits would be difficult and inappropriate.

Based upon the economic analysis, MSHA has determined that this rule is not an economically significant regulatory action pursuant to section 3(f)(1) of Executive Order 12866. The Agency does consider this rulemaking significant under section 3(f)(4) of the Executive Order for other reasons, and has so designated the rule in its annual agenda. This means that while the Office of Management and Budget was provided an opportunity to review this proposal and the preliminary RIA (as discussed in the History section of this preamble), specific determinations of the costs and benefits are not required pursuant to section 6(a)(3)(C) of the Executive Order.

(C) Paperwork Reduction Act

This proposed rule contains information collections which are subject to review by the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995 (PRA95). The title, description, and respondent description of the information collection are shown below with an estimate of the annual reporting burden. Included in the estimate is the time for reviewing instructions, gathering and maintaining the data needed, and completing and reviewing the collection of information. With respect to the following collection of information, MSHA invites comments on: (1) Whether the proposed collection of information is necessary for proper performance of MSHA's functions, including whether the information will have practical utility; (2) the accuracy of MSHA's estimate of the burden of the proposed collection of information, including the validity of the methodology and assumptions used; (3) ways to enhance the quality, utility, and

clarity of information to be collected; and (4) ways to minimize the burden of the collection of information on respondents, including through the use of automated collection techniques, when appropriate, and other forms of information technology.

These estimates are an approximation of the average time expected to be necessary for a collection of information. They are based on such information as is available to MSHA.

Submission

The Agency has submitted a copy of this proposed rule to OMB for its review and approval of these information collections. Interested persons are requested to send comments regarding this information collection, including suggestions for reducing this burden, to the Office of Information and Regulatory Affairs, OMB New Executive Office Bldg., 725 17th St. NW., Rm. 10235, Washington, DC 20503, Attn: Desk Officer for MSHA. Submit written comments on the information collection not later than February 18, 1997.

Description of Respondents

Those required to provide the information are mine operators and individuals who are paid to perform tasks for the mine operator (e.g., physicians reporting the results of audiograms to the mine operator).

Description

The proposal contains information collection requirements in §§ 62.120, 62.130, 62.140, 62.150, 62.160, 62.170, 62.180, 62.190, 62.200, and 62.210. The following chart presents the paperwork requirements by section.

NET INFORMATION COLLECTION BURDEN HOURS BY PROPOSED SECTION

Section	Paperwork requirement and associated tasks	Hours
62.120	Evaluate miners' noise exposure; notify miner of overexposure; prepare and post administrative controls; give miners copy of administrative controls.	(135,250)
62.130	Prepare and file a training certification	10,270
62.140	Perform audiograms; notify miners to appear for testing and need to avoid high noise	69,930
62.150	Compile an audiometric test record; obtain a certification	9,175
62.160	Provide information and audiometric test record; perform audiometric retests	21,350
62.170	Perform otological evaluations and provide information and notice	1,045
62.180	Prepare a training certification for retrained miners; review effectiveness of engineering and administrative controls	700
62.190	Inform miner of test results; inform miner of STS	6,300
62.200	Provide access to records	1,255
62.210	Transfer records	235
Total		(14,985)

These paperwork requirements have been submitted to the Office of Management and Budget (OMB) for review under section 3504(h) of the Paperwork Reduction Act of 1995 (PRA 95). Respondents are not required to respond to any collection of information unless it displays a currently valid OMB control number.

The following chart summaries MSHA's estimates by section in tabular form. Data is distributed by commodity. All numbers have been rounded.

NET INFORMATION COLLECTION BURDEN HOURS BY COMMODITY

Task		Coal	Metal/ nonmetal
62.120	Limitations on Noise Exposure	(140,545)	5,295
62.130	Training	4,000	6,270
62.140	Audiometric Testing Program	30,655	39,275
62.150	Audiometric Test Procedures	3,930	5,245
62.160	Evaluation of Audiograms	9,340	12,015
62.170	Followup Evaluation	475	570
62.180	Followup Corrective Measures	335	365
62.190	Notification of Results	2,715	3,585
62.200	Access to Records	255	1,000
62.210	Transfer of Records	100	135
Total (discrepancies due to rounding)		(88,740)	73,755

Alternatively, the paperwork hours may be distributed between small and large mines. The following table provides this analysis. Small mines are those with less than 20 employees.

NET INFORMATION COLLECTION BURDEN HOURS BY MINE SIZE

Task		Small	Large
62.120	Limitations on Noise Exposure	(15,510)	(119,740)
62.130	Training	2,965	7,305
62.140	Audiometric Testing Program	19,270	50,660
62.150	Audiometric Test Procedures	2,885	6,290
62.160	Evaluation of Audiograms	6,185	15,170
62.170	Followup Evaluation	250	800
62.180	Followup Corrective Measures	160	540

NET INFORMATION COLLECTION BURDEN HOURS BY MINE SIZE—Continued

Task	Small	Large
62.190 Notification of Results	1,935	4,365
62.200 Access to Records	500	755
62.210 Transfer of Records	185	50
Total (discrepancies due to rounding)	18,825	(33,805)

Metal/nonmetal mines would incur 75,080 burden hours under the proposal and coal mines would incur 55,675 hours. For metal/nonmetal mines, the existing burden is 1,325 hours as defined and calculated under PRA 95; this makes the net burden for metal/nonmetal mines 73,755 hours. For coal mines, the net burden is 88,740 fewer hours than the existing burden as calculated under PRA 95. The proposal would result in a net decrease of 14,985 burden hours associated with information collection from that associated with the current requirements. It should be noted that the existing burden hours are currently approved in three separate paperwork packages and reflect burden hours calculated under the provisions of the 1980 Paperwork Reduction Act (PRA 80). MSHA is in the process of updating and combining these three packages. The Agency's official paperwork submission accompanying this proposal includes a chart comparing the existing burden hours under PRA 80, the existing burden hours under PRA 95, and the proposed burden hours under PRA 95.

Additional detail is presented in the charts that follow. These charts provide annual and annualized paperwork burden hours as measured by PRA 95. Burden hours for tasks which predominantly would occur in the first year only, dose determination and notification, are presented in annualized form. Proposed §§ 62.140(b)(3), 62.250 (b) and (c), 62.160 (a)(1) and (a)(3), 62.170 (b) and (c), 62.180(a), 62.190 (a)(1) and (a)(2), 62.200(b) and 62.210(a) are anticipated to require the paperwork burden of the mine operator providing instructions to the clerical worker. This burden is included in the total hours per regulation column.

Regulation	Number of respondents	Hours per response	Number of responses	Number of responses per respondent	Total hours per regulation	Maintenance and operating costs	Annualized capital costs
Small Metal and Nonmetal Mines							
62.120(f)(1)	6,218	2.00	n/a	n/a	3,530	$597,922	$1,315,604
62.120(f)(2)	6,218	0.08	35,300	6	490	1,253	0
62.120(c)(1)	18	1.75	18	1	25	0	0
62.120(c)(1)	18	0.05	103	5	5	26	0
62.130(b)	6,218	0.05	35,300	6	2,385	8,825	0
62.140(b)(1)	2,430	1.00	13,779	6	13,780	413,370	0
62.140(b)(3)	2,430	0.08	13,779	6	1,345	3,445	0
62.150(b)	2,430	0.08	13,779	6	1,345	3,445	0
62.150(c)	2,430	0.05	13,779	6	930	3,445	0
62.160(b)(1)	300	1.50	1,720	6	2,585	86,000	0
62.160(a)(1)	2,430	0.08	13,779	6	1,345	3,445	0
62.160(a)(3)	2,430	0.05	13,779	6	930	3,445	0
62.170(a)	15	2.00	90	6	180	22,500	0
62.170(b)	15	0.08	90	6	9	23	0
62.170(c)	15	0.08	90	6	9	23	0
62.180(a)	320	0.05	1,808	6	90	452	0
62.180(c)	15	2.00	15	1	20	0	0
62.190(a)(1)	2,430	0.08	13,779	6	1,345	3,445	0
62.190(a)(2)	320	0.08	1,812	6	180	1,461	0
62.200(b)	60	0.10	4,374	12	440	1,094	0
62.210(a)	361	0.25	361	1	125	0	0
Monitoring (existing)	1,705	2.00	n/a	n/a	970	163,953	360,744
Large Metal and Nonmetal Mines							
62.120(f)(1)	1,023	5.00	n/a	n/a	1,455	$98,372	$216,446
62.120(f)(2)	1,023	0.08	75,700	75	875	2,687	0
62.120(c)(1)	40	2.25	40	1	90	0	0
62.120(c)(1)	40	0.05	2,972	70	150	726	0
62.130(b)	1,023	0.05	75,700	75	3,885	18,925	0
62.140(b)(1)	301	1.00	22,328	75	22,330	669,840	0
62.140(b)(3)	301	0.08	22,328	75	1,820	5,582	0
62.150(b)	301	0.08	22,328	75	1,820	5,582	0
62.150(c)	301	0.05	22,328	75	1,150	5,582	0
62.160(b)(1)	40	1.50	2,790	70	4,185	139,500	0
62.160(a)(1)	301	0.08	22,328	70	1,820	5,582	0
62.160(a)(3)	301	0.05	22,328	70	1,150	5,582	0
62.170(a)	2	2.00	174	85	344	43,500	0
62.170(b)	2	0.08	174	85	15	44	0

Regulation	Number of respondents	Hours per response	Number of responses	Number of responses per respondent	Total hours per regulation	Maintenance and operating costs	Annualized capital costs
62.170(c)	2	0.08	174	85	15	44	0
62.180(a)	50	0.05	3,490	70	175	873	0
62.180(c)	35	2.25	35	1	80	0	0
62.190(a)(1)	301	0.08	22,328	75	1,820	5,582	0
62.190(a)(2)	40	0.08	2,965	70	240	742	0
62.200(b)	10	0.10	5,601	560	560	1,400	0
62.210(a)	10	1.00	10	1	10	0	0
Monitoring (existing)	250	5.00	n/a	n/a	355	24,040	52,895
Small Coal Mines							
62.120(f)(1)	1,255	2.00	n/a	n/a	715	$120,681	$265,533
62.120(f)(2)	1,255	0.08	9,020	7	120	320	0
62.120(c)(1)	20	1.75	20	1	30	0	0
62.120(c)(1)	20	0.05	173	7	10	43	0
62.130(b)	1,255	0.05	9,020	7	580	2,255	0
62.140(b)(1)	536	1.00	3,851	7	3,851	115,530	0
62.140(b)(3)	536	0.08	3,851	7	360	963	0
62.150(b)	536	0.08	3,851	7	360	963	0
62.150(c)	536	0.05	3,851	7	250	963	0
62.160(b)(1)	70	1.50	480	7	720	24,050	0
62.160(a)(1)	536	0.08	3,851	7	360	1,926	0
62.160(a)(3)	536	0.05	3,851	7	250	0	0
62.170(a)	4	2.00	24	6	48	6,000	0
62.170(b)	4	0.08	24	6	2	6	0
62.170(c)	4	0.08	24	6	2	6	0
62.180(a)	60	0.05	507	8	25	127	0
62.180(c)	20	1.25	20	1	25	0	0
62.190(a)(1)	536	0.05	3,851	7	360	963	0
62.190(a)(2)	73	0.05	505	7	50	126	0
62.200(b)	15	0.10	610	40	60	131	0
62.210(a)	160	0.25	160	1	60	0	0
Monitoring (existing)	1,762	0.50	25,334	14	12,670	357,492	169,434
Audiograms (existing)	35	1.00	74	2	70	2,220	0
Supplemental Noise Survey	420	0.05	840	2	(120)	0	0
Supplemental Noise Survey	420	0.25	5,980	14	(2,990)	0	0
Written HCP	90	6.00	90	1	(535)	0	0
Calibration Reports	1,762	0.25	1,762	1	(440)	0	0
Survey Reports	1,762	0.05	1,762	1	(90)	0	0
Monitoring Records	1,762	0.10	25,334	14	(2,530)	0	0
Survey Certificates	1,762	0.05	1,762	1	(90)	0	0
Large Coal Mines							
62.120(f)(1)	890	5.00	n/a	n/a	1,265	$85,582	$188,306
62.120(f)(2)	890	0.08	66,667	75	770	2,367	0
62.120(c)(1)	45	2.25	45	1	75	1,309	0
62.120(c)(1)	45	0.05	5,237	75	290	0	0
62.130(b)	890	0.05	66,667	75	3,420	16,667	0
62.140(b)(1)	334	1.00	25,007	75	25,007	750,210	0
62.140(b)(3)	334	0.08	25,007	75	2,035	6,252	0
62.150(b)	334	0.08	25,007	75	2,035	6,252	0
62.150(c)	334	0.05	25,007	75	1,285	6,252	0
62.160(b)(1)	40	1.50	3,126	80	4,690	156,300	0
62.160(a)(1)	334	0.08	25,007	80	2,035	6,252	0
62.160(a)(3)	334	0.05	25,007	80	1,285	6,252	0
62.170(a)	3	2.00	196	65	392	49,000	0
62.170(b)	3	0.08	196	65	16	49	0
62.170(c)	3	0.08	196	65	16	49	0
62.180(a)	400	0.05	3,908	35	195	977	0
62.180(c)	40	2.25	40	1	90	0	0
62.190(a)(1)	334	0.05	25,007	75	2,035	6,252	0
62.190(a)(2)	40	0.05	3,322	80	270	831	0
62.200(b)	10	0.10	1,934	194	195	484	0
62.210(c)	40	1.00	40	1	40	0	0
Monitoring existing	1,134	0.50	169,424	150	84,710	230,077	239,932
Audiograms (existing)	6	1.00	542	90	540	0	0

Regulation	Number of respondents	Hours per response	Number of responses	Number of responses per respondent	Total hours per regulation	Maintenance and operating costs	Annualized capital costs
Supplemental Noise Survey	293	0.05	43,712	150	(21,860)	0	0
Supplemental Noise Survey	293	0.25	293	1	(40)	0	0
Written HCP	67	6.00	67	1	(405)	0	0
Calibration Reports	1,134	0.25	1,134	1	(280)	0	0
Survey Reports	1,134	0.05	1,134	1	(60)	0	0
Monitoring Records	1,134	0.10	169,424	150	(16,940)	0	0
Survey Certificates	1,134	0.05	1,134	1	(60)	0	0

(D) Regulatory Flexibility Act

In accordance with § 605 of the Regulatory Flexibility Act (RFA), the Mine Safety and Health Administration certifies that the noise proposal does not have a significant economic impact on a substantial number of small entities. MSHA considers small mines to be mines with fewer than 20 employees. However, for the purposes of the RFA and this certification, MSHA has also evaluated the impact of the proposal on mines up to and including those with fewer than 500 employees. No small governmental jurisdictions or nonprofit organizations are affected. Under the Small Business Regulatory Enforcement Fairness Act (SBREFA) amendments to the RFA, MSHA must include in the proposal a factual basis for this certification. The Agency also must publish the regulatory flexibility certification statement in the Federal Register, along with the factual basis, followed by an opportunity for comment by the public. The Agency has consulted with the Small Business Administration (SBA) Office of Advocacy and believes that this analysis provides a reasonable basis for the certification in this case.

MSHA specifically solicits comment on the Agency's determination in this regulatory flexibility certification statement, including cost data and data sources. To facilitate the public participation in the rulemaking process, MSHA will mail a copy of the proposed rule, including the preamble and regulatory flexibility certification statement, to every mine operator.

Factual Basis for Certification

The Agency has used a quantitative approach in concluding that the proposed rule does not have a significant impact on a substantial number of small entities. The Agency performed its analysis separately for two groups of mines: the coal mining sector as a whole, and the metal and nonmetal mining sector as a whole. Based on a review of available sources of public data on the mining industry, the Agency believes that a quantitative analysis of the impacts on various mining subsectors (i.e., beyond the 4-digit SIC level) may not be feasible. The Agency requests comments, however, on whether there are special circumstances that warrant separate quantification of the impact of this proposal on any mining subsector, and information on how it might readily obtain the data necessary to conduct such a quantitative analysis. The Agency is fully cognizant of the diversity of mining operations in each sector, and has applied that knowledge as it developed the proposal.

Under the RFA, MSHA must use the SBA definition for a small mine of 500 employees or fewer or, after consultation with the SBA Office of Advocacy, establish an alternative definition for the mining industry by publishing that definition in the Federal Register for notice and comment. The alternative definition could be the Agency's traditional definition of ''fewer than 20 miners,'' or some other definition. As reflected in the certification, MSHA analyzed the costs of this proposal for small and large mines using both the traditional Agency definition, and SBA's definition, as required by RFA, of a small mine. The Agency compared the costs of the proposal for small mines in each sector to the revenues and profits for each sector for every size category analyzed. In each case, the results indicated that the costs as a percent of revenue are less than 1%. Further, the costs do not appear to have any appreciable impact on profits.

The following table summarizes the results of this analysis for mines which employ fewer than 500 miners, at various sizes.

SMALL MINES: COSTS COMPARED TO REVENUES AND PROFITS

	Estimated costs (thous.)	Estimated revenue (millions)	Average profit as % of revenue	Total estimated profits (millions)	Estimated cost per small mine	Cost as % of revenue	Cost as % of profit
Coal Mines:							
Small <20	($45)	$855	3.82	$33	($26)	−0.01	−0.14
Large >=20	332	19,094	3.82	729	293	0.00	0.05
Small <50	586	3,542	3.82	135	237	0.02	0.43
Large >=50	(300)	16,408	3.82	627	(709)	0.00	−0.05
Small <100	832	6,061	3.82	232	309	0.01	0.36
Large >=100	(545)	13,888	3.82	531	(2,684)	0.00	−0.10
Small <250	677	12,624	3.82	482	240	0.01	0.14
Large >=250	(391)	7,326	3.82	280	(5,140)	−0.01	−0.14
Small <500	382	19,117	3.82	730	132	0.00	0.05
Large >=500	(95)	831	3.82	32	(8,660)	−0.01	-0.30
M/NM Mines:							
Small <20	4,437	11,929	4.55	543	479	0.04	0.82
Large >=20	3,600	26,071	4.55	1,186	2,324	0.01	0.30
Small <50	5,731	18,814	4.55	856	557	0.03	0.67
Large >=50	2,306	19,186	4.55	873	4,359	0.01	0.26

SMALL MINES: COSTS COMPARED TO REVENUES AND PROFITS—Continued

	Estimated costs (thous.)	Estimated revenue (millions)	Average profit as % of revenue	Total estimated profits (millions)	Estimated cost per small mine	Cost as % of revenue	Cost as % of profit
Small <100	6,323	23,047	4.55	1,049	599	0.03	0.60
Large >=100	1,714	14,953	4.55	680	6,418	0.01	0.25
Small <250	7,037	29,558	4.55	1,345	655	0.02	0.52
Large >=250	1,000	8,442	4.55	384	14,492	0.01	0.26
Small <500	7,571	32,134	4.55	1,462	702	0.02	0.52
Large >=500	466	5,866	4.55	267	17,249	0.01	0.17

In determining revenues for coal mines, MSHA multiplied coal production data (in tons) for mines in specific size categories (reported to MSHA quarterly) by the average price per ton (from the Department of Energy, Energy Information Administration, *Annual Energy Review 1995*). For metal and nonmetal mines, the Agency estimated revenues for specific mine size categories as the proportionate share of these mines' contribution to the Gross National Product (from the Department of the Interior, former Bureau of Mines, *Mineral Commodity Summaries 1996*). Average profit as a percent of revenue for both coal mines and metal and nonmetal mines comes from Dun & Bradstreet Information Services, *Industry Norms & Key Business Ratios*, 1993–94.

Based on the information in the Agency's preliminary Regulatory Impact Analysis (summarized in the ''costs'' table in the Question and Answer section of this preamble), the costs of the proposal for all metal and nonmetal mines with fewer than 20 employees would be $4.6 million; the average cost of the proposal for a small metal and nonmetal mine with fewer than 20 employees is about $500. The average cost of the proposal for a small metal and nonmetal mine with fewer than 500 employees is about $700. For small coal mines with fewer than 20 employees, the proposal is estimated to result in a small net savings of about $30. This savings results from the proposed elimination of a substantial paperwork burden that now exists in the coal mine sector for monitoring miners' noise exposures. For small coal mines with fewer than 500 employees, the proposal is estimated to result in a small net cost of about $130.

Regulatory Alternatives Rejected

The limited impacts on small mines, regardless of size definition, reflect decisions by MSHA not to propose more costly regulatory alternatives. In considering regulatory alternatives for small mines, MSHA must observe the requirements of its authorizing statute. Section 101(a)(6)(A) of the Mine Act requires the Secretary to set standards which most adequately assure, on the basis of the best available evidence, that no miner will suffer material impairment of health over his/her working lifetime. In addition, the Mine Act requires that the Secretary, when promulgating mandatory standards pertaining to toxic materials or harmful physical agents, consider other factors, such as the latest scientific data in the field, the feasibility of the standard and experience gained under the Act and other health and safety laws. Thus, the Mine Act requires that the Secretary, in promulgating a standard, attain the highest degree of health and safety protection for the miner, based on the ''best available evidence,'' with feasibility as a consideration.

As a result of this statutory requirement, MSHA seriously considered two alternatives that would have significantly increased costs for small mine operators—lowering the PEL to a TWA_8 of 85 dBA, and lowering the exchange rate to 3 dB. In both cases, the scientific evidence in favor of these approaches was strong. But in both cases, for the purpose of this proposal, MSHA has concluded that it may not be feasible for the mining industry to accomplish these more protective approaches. The impact of these approaches on small mine operators was an important consideration in this regard. Part IV of this preamble contains a full discussion of MSHA's preliminary conclusions about these alternatives. The public is invited to propose other alternatives for consideration.

Paperwork Impact

In accordance with the Regulatory Flexibility Act and the Paperwork Reduction Act of 1995 (PRA 95), MSHA has analyzed the paperwork burden for small mines. While the proposal results in a net paperwork burden decrease for all mines, it results in an increase in paperwork hours. For mines with fewer than 20 miners the proposal would result in an increase of about 18,800 hours, and with fewer than 500 miners it would result in a decrease of about 14,985 hours. The bulk of the new hours (greater than 80%) is derived from the audiometric testing program and procedures. While mines with fewer than 20 employees in the coal and metal and nonmetal sectors will have extra burden hours associated with new requirements, the net burden hours for small coal mines are actually reduced, because the proposal would eliminate current requirements for biannual noise surveys and other miscellaneous reports and surveys in that sector. However, at this size level, there are more metal and nonmetal mines than there are coal mines. Thus, at this size level, the proposal would result in a net gain in paperwork burdens.

As required by PRA 95, MSHA has included in its paperwork burden estimates the time needed to perform tasks associated with information collection. For example, the proposed rule requires a mine operator to notify a miner if the miner's noise exposure exceeds the action level. In order to determine if notification is necessary, the mine operator must perform dose determination monitoring. Although completion of the notification would take 0.05 hour on average, the time for dose determination must be included in the burden estimate according to the new paperwork law. The proposal's average paperwork burden per small metal and nonmetal mine is 4.8 hours and per small coal mine is 6 hours per year.

Other Relevant Matters

In accordance with the Small Business Regulatory Enforcement Fairness Act (SBREFA), MSHA is taking actions to minimize the compliance burden on small mines. As discussed in the ''Questions and Answers'' section of this preamble, MSHA is committed to writing the final rule in plain English, so that it can be easily understood by small mine operators. The proposed effective date of the rule would be a year after final promulgation, to provide adequate time for small mines to achieve compliance. Also, as stated

previously, MSHA will mail a copy of the proposed rule to every mine operator which primarily benefits small mine operators. The Agency has committed itself to issuance of a compliance guide for all mines, and has invited comment on whether compliance workshops or other such approaches would be valuable.

MSHA is considering whether to continue to use ''fewer than 20 miners'' as the definition of a small mine for purposes of the Regulatory Flexibility Act (RFA). For this rulemaking's Regulatory Flexibility Analysis, the Agency is using fewer than 20 employees, in addition to the SBA's definition of fewer than 500, as required by the RFA. MSHA presently is consulting with the SBA Office of the Chief Counsel for Advocacy in order to determine an appropriate definition to propose to the public for comment in the future. For purposes of this proposed rule on noise, MSHA has continued its past practice of using ''under 20 miners'' as the appropriate point of reference, in addition to SBA's definition. Reviewers will note that the paperwork and cost discussions continue to refer to the impacts on ''small'' mines with fewer than 20 employees. The Agency has not established a definition of ''small entity'' for purposes of the final rule. Based on this analysis, MSHA concludes that whatever definition of ''small entity'' is eventually selected, the proposed noise rule does not have a significant economic impact on a substantial number of small entities.

(E) Unfunded Mandates Act

MSHA has determined that, for purposes of § 202 of the Unfunded Mandates Reform Act of 1995, this proposal does not include any Federal mandate that may result in increased expenditures by State, local, or tribal governments in the aggregate of more than $100 million, or increased expenditures by the private sector of more than $100 million. Moreover, the Agency has determined that for purposes of § 203 of that Act, this proposed rule does not significantly or uniquely affect small governments.

Background

The Unfunded Mandates Reform Act was enacted in 1995. While much of the Act is designed to assist the Congress in determining whether its actions will impose costly new mandates on State, local, and tribal governments, the Act also includes requirements to assist Federal agencies to make this same determination with respect to regulatory actions.

Analysis

Based on the analysis in the Agency's preliminary Regulatory Impact Statement (summarized in the ''cost'' table in the Questions and Answers section of this preamble), the cost of this proposed rule for the entire mining industry is less than $10 million. Accordingly, there is no need for further analysis under § 202 of the Unfunded Mandates Reform Act.

MSHA has concluded that small governmental entities are not significantly or uniquely impacted by the proposed regulation. The proposed rule will impact approximately 14,000 coal and metal and nonmetal mining operations; however, increased costs would be incurred only by those operations where noise exposures exceed the allowable limits. MSHA estimates that approximately 350 sand and gravel or crushed stone operations are run by state, local, or tribal governments and would be impacted by this rule. MSHA anticipates that these entities would be able to reduce noise exposure below the PEL via engineering and administrative controls and would not need to use a Hearing Conservation Program, thereby minimizing their costs. MSHA estimates that increased costs for these entities would be about $500 per year which would be partially offset by reduced worker compensation costs. Other tangible benefits include reduction in the number of cases of hearing impairment in these entities.

When MSHA issues the proposed rule, the Agency will affirmatively seek input of any state, local, and tribal government which may be affected by the noise rulemaking. This would include state and local governmental entities who operate sand and gravel mines in the construction and repair of highways and roads. MSHA will mail a copy of the proposed rule to approximately 350 such entities.

Following is MSHA's state-by-state listing of sand and gravel mines owned or operated by state or local governments.

The Agency welcomes any corrections.

STATE/COUNTY OWNED/OPERATED SAND AND GRAVEL OPERATIONS

[As of 12/08/95]

State	State owned	County owned	City owned
ARIZONA	2	2	
ARKANSAS		5	
CALIFORNIA		4	
COLORADO	4	27	
IDAHO		13	
ILLINOIS		2	
INDIANA		5	
IOWA		2	
KANSAS		2	
MAINE	5		
MARYLAND			6
MICHIGAN		8	
MISSISSIPPI		5	
MISSOURI		8	
MONTANA	8	34	
NEBRASKA		2	
NEVADA		1	
NEW MEXICO		4	
NEW YORK		15	95
OKLAHOMA		2	
OREGON		11	
PENNSYLVANIA			1
SOUTH CAROLINA		1	
SOUTH DAKOTA		15	
TENNESSEE		3	
TEXAS		6	
UTAH	1	5	
VERMONT			11
WASHINGTON		9	
WISCONSIN		20	1
WYOMING		1	
Total 346	20	212	114

(F) Rulemaking History

MSHA's noise standards in metal and nonmetal mines (30 CFR 56/57.5050) and in coal mines (§§ 70.500 through 70.511, and §§ 71.800 through 71.805) were first published in the early 1970's. These standards, derived from the Walsh-Healey Public Contracts Act occupational noise standard, adopted a TWA_8 PEL of 90 dBA and a 5-dB exchange rate.

Because of the differences between the standards for coal mines and those for metal and nonmetal mines, members of the mining community with operations in coal and metal and nonmetal requested that MSHA revise its standards to provide one set of noise standards covering all mines. Other mine operators with facilities regulated by both MSHA and OSHA suggested that MSHA promulgate noise standards which are generally consistent with OSHA standards. The United Mine Workers also requested that the Agency reconsider the existing standards to address several asserted deficiencies.

Based on these comments and the incidence of noise-induced hearing loss (NIHL) among miners, the Agency published an Advanced Notice of Proposed Rulemaking (ANPRM) on December 4, 1989 (54 FR 50209). In this

ANPRM, the Agency solicited information for revision of the noise standards for coal and metal and nonmetal mines. The Agency received numerous comments which are reflected in this proposal from mine operators, trade associations, labor groups, equipment manufacturers, and other interested parties.

A draft of the proposed rule and accompanying analyses was sent to the Office of Management and Budget and to the Chief Counsel for Advocacy of the Small Business Administration, in accordance with law and Executive Order. Consultations with these two agencies were completed within 90 days. No substantive changes to the proposal were recommended during these consultations, nor were any made by MSHA. The Agency did receive valuable advice on the presentation of its initial Regulatory Flexibility Analysis and on displaying the results of its paperwork analysis, so as to better highlight the Agency's compliance with PRA 95 and SBREFA.

In the Spring of 1996, the National Institute for Occupational Safety and Health (NIOSH) released for peer review a draft criteria document for occupational noise exposure to update the one issued in 1972. As indicated previously (see response to Question 6 in ''Questions and Answers''), MSHA has determined that it would not be appropriate to delay publication of this proposed rule to await the issuance of the final NIOSH criteria document.

A summary of the draft criteria document, prepared by NIOSH, is reprinted here verbatim for those in the mining community who have not otherwise received copies. This summary should provide ample notice of the position NIOSH may be taking in a new criteria document.

April 16, 1996—(NIOSH) Summary of Recommendations, Criteria for a Recommended Standard: Occupational Noise Exposure

1. Hearing Impairment and Risk Assessment

The protection goal incorporated in most definitions of hearing impairment has been to preserve hearing at critical audiometric frequencies for speech discrimination. Hearing impairment as defined by NIOSH in 1972 was an average of the hearing threshold levels (HTLs) at the audiometric frequencies of 1000, 2000 and 3000 Hertz (Hz) that exceeded 25 decibels (dB). The 4000-Hz audiometric frequency has been recognized as being not only sensitive to noise but also extremely important for hearing and understanding speech in unfavorable or noisy listening conditions. Because listening conditions are not always ideal in everyday life, and on the basis of the American Speech Language-Hearing Association Task Force's proposal made in 1981, NIOSH has modified its definition of hearing impairment to include the 4000-Hz audiometric frequency for use in assessing the risk of occupational NIHL. Hence, with this modification, NIOSH defines material hearing impairment as an average of the HTLs at 1000, 2000, 3000 and 4000 Hz that exceeds 25 dB.

Because of the prolific occupational use of hearing protectors since the early 1980's, new data that can be used to determine dose-response relationships for NIHL in U.S. workers are not known to exist. NIOSH recently conducted a risk assessment on occupational noise-induced hearing loss (NIHL) using the original definition of hearing impairment and the hearing data from the 1972 criteria document. Although the risk model used in the new assessment is different from the risk model used in 1972, the excess risk estimates derived in the new assessment are comparable to those published in 1972. The excess risk at age 60 from a 40-year occupational exposure to an average daily noise level of 85 decibels, a weighted network (dBA) is approximately 14%, versus the 16% published in 1972. With the new NIOSH definition of hearing impairment, and based on the new risk assessment, the excess risk at the 85-dBA REL is 8%. Thus, the new risk assessment did not revise the excess risk at the 85-dBA REL upward, and although there is still evidence of excess risk at exposure levels below 85 dBA, NIOSH is recommending that the current REL be retained.

2. Exchange Rate

Health effect outcomes are dependent on exposure level and duration. This relationship is called the ''exchange rate,'' which is the increment in decibels that requires the halving of exposure time. The most commonly used exchange rates are 3 dB and 5 dB. A 3-dB exchange rate requires that noise exposure time be halved for each 3-dB increase in noise level; likewise, a 5-dB exchange rate requires that exposure time be halved for each 5-dB increase. NIOSH now recommends the 3-dB exchange rate. The 1972 criteria document recommended the 5-dB exchange rate, which is what OSHA and MSHA currently enforce. There is more scientific, although not unequivocal, support for the 3-dB exchange rate than for the 5-dB exchange rate, which is not based on scientific data and is derived from a series of over-simplifications of the original criteria. The 3-dB exchange rate is recommended by the International Organization for Standardization (ISO), and it is now enforced by most European countries and some provinces of Canada. In the U.S., there have been recent ''converts'' to the 3-dB exchange rate: the U.S. Air Force in 1993; and the American Conference of Governmental Industrial Hygienists and the U.S. Army in 1994.

3. Ceiling Limit

In the 1972 criteria document, NIOSH recommended a ceiling limit of 115 dBA, which is retained in this draft criteria document. Exposures to noise levels greater than 115 dBA would not be permitted regardless of the duration of the exposure. This ceiling limit is based on the assumption that above a critical intensity level the ear's response to energy no longer has a relation to the duration of the exposure, but is only related to the intensity of the exposure. Recent research with animals indicates that the critical level is between 115 and 120 dBA. Below this critical level, the amount of hearing loss is related to the intensity and duration of exposure; but above this critical level, the relationship does not hold. For a noise standard to be protective, there should be a noise ceiling level above which no unprotected exposure is permitted. Given the recent data, 115 dBA is a reasonable ceiling limit beyond which no unprotected exposure should be permitted.

4. Hearing Protectors

One consideration for selecting a hearing protector would be its noise reduction capabilities, which are expressed in terms of a noise reduction rating (NRR). The NRR is a single-number, laboratory-derived rating required by the Environmental Protection Agency (EPA) to be shown on the label of each hearing protector sold in the U.S. In the late 1970's and early 1980's, two NIOSH field studies found that insert-type hearing protectors in the field provided less than one-half the attenuation measured in the laboratory, and since the 1970's, 22 additional studies of ''real-world'' attenuation with a variety of hearing protectors have shown similar results.

In calculating the noise exposure to the wearer of a hearing protector, OSHA has implemented the practice of derating the NRR by one-half for all types of hearing protectors. In the 1972 criteria document, NIOSH recommended the use of the equivalent full NRR value, but now it recommends derating the NRR by 25%, 50% and 70% for earmuffs, formable earplugs and all other earplugs, respectively. This derating scheme is not perfect and is intended only as an interim recommendation. If the testing and labeling requirements for hearing protectors are to be changed, EPA must initiate the rulemaking procedures because it has the statutory authority. Given that the funding for EPA's Office of Noise Abatement and Control was eliminated in the early 1980's, this change is unlikely to occur in the near future.

The draft also recommends that hearing protectors be worn for any noise exposure over 85 dBA, regardless of exposure duration. This measure is simplistic but extremely protective because its implementation does not require the calculation of time-weighted-average (TWA) exposures. This ''hard-hat'' approach, as opposed to predicating the requirement on TWA exposures, is a departure from what was recommended in 1972. It appears to be a prudent policy, which the U.S. Army has been using for years, but there are no data in the document to support this recommendation.

5. Exposure Level Requiring a Hearing Loss Prevention Program

In this draft document, the requirement for a hearing loss prevention program (HLPP), which includes audiometry, worker education, etc., is triggered by the exposure level of 82 dBA, 8-hour TWA (i.e., ½ of the REL). This level is essentially an ''action level''—a concept developed in the mid-

1970's to address interday exposure variability and later adopted in the Standards Completion Program as ½ of an exposure limit. In the 1972 criteria document, which preceded the Standards Completion Program, the requirement for a HLPP began at the REL of 85 dBA, 8-hour TWA.

6. Types and Frequency of Audiometric Examinations

In this draft document, the recommended types (i.e., baseline, monitoring, confirmation and exit audiograms) and frequency of audiometric examinations are different from those in the 1972 criteria document. The new recommendations are in line with current practices in HLPPs.

7. Significant Threshold Shift

Significant threshold shift is a shift in hearing threshold levels, outside the range of audiometric testing variability (±5 dB), that warrants follow-up action to prevent further hearing loss. NIOSH recommends an improved significant threshold shift criterion, which is an increase of 15 dB in hearing threshold at 500, 1000, 2000, 3000, 4000, or 6000 Hz that is repeated for the same ear and frequency in back-to-back tests. This criterion is different from that in the 1972 criteria document, and has been selected from among several criteria on the bases of their relative sensitivity and specificity. The new criterion has the advantages of a high identification rate (identifying those workers whose hearing thresholds have shifted toward higher levels) and a low false-positive rate.

8. Age Correction on Audiogram

NIOSH recommends that age correction not be applied to an individual's audiogram for the calculation of a significant threshold shift. Although many people experience some decrease in hearing sensitivity with age, age correction cannot be accurately applied to audiograms in determining an individual's significant threshold shift because the data on age-related hearing losses describe only the statistical distributions in populations. Thus, the median hearing loss attributable to presbycusis for a given age group will not be generalizable to the presbycusis experienced by an individual in that age group. The argument for age correction has been that the employer should not be penalized for hearing losses due to ageing. In the 1972 criteria document, NIOSH recommended age correction but did not provide a rationale for it.

9. Evaluation of Program Effectiveness

To assess the effectiveness of a HLPP, it is necessary to have an evaluation method that can monitor trends in the population of workers enrolled in the program and thus indicate program effectiveness before many individual shifts occur. In general, NIOSH suggests that the success of a smaller HLPP should be judged by the audiometric results of individual workers. An overall program evaluation becomes critical when the number of workers grows so large that one cannot simply look at each worker's audiometric results and get an adequate picture of the program's efficacy. At the present time, there is not one generally accepted method for the overall evaluation of HLPPs. NIOSH recommends a significant threshold shift incidence rate of 5% or less as evidence of an effective HLPP. This method is currently the simplest procedure available, and has no more disadvantages than other potential evaluation methods.

10. American National Standards Institute (ANSI)

In the 1972 criteria document, NIOSH recommended several ANSI standards for quality assurance in audiometry and in noise measurements. Since then, these standards have been updated several times. In the draft document, NIOSH recommends that these standards be superseded with the latest versions as they become available. The major advantage for this ''blanket'' endorsement is that the revised criteria document will stay current with changing technology.

II. The Risks to Miners

This part of the preamble sets out the evidence collected by MSHA to date with respect to whether there is a continuing risk to miners of exposure to harmful levels of noise, despite existing standards, and evidence on the level of that risk. Based upon this information, MSHA has concluded that workplace noise exposure does continue to pose a significant risk of material impairment of health and functional capacity to miners.

The data presented in this part provide a profile of the mining population at risk at different levels of workplace noise exposure. The noise exposure limitations being proposed by the Agency, described in part III, would not eliminate the risk of material impairment—although they would cut the present risk by two-thirds. (The feasibility of further reducing risk is discussed in part IV. The data in this part II were utilized by the Agency to assist it in determining the cost to industry of reducing risk to various levels, and thus in reaching the Agency's conclusions about economic feasibility.)

There are a number of technical terms used throughout this section. Reviewers not familiar with noise terminology should refer to the discussion in part III of this preamble concerning proposed § 62.110, *Definitions.*

All the studies discussed and cited in this part are included in the references listed in part V, along with similar studies reviewed by the Agency. All constitute part of the Agency's rulemaking record.

The Agency is interested in receiving additional data with respect to the risks of noise exposure.

Defining the Problem

Noise is one of the most pervasive health hazards in mining. Exposure to hazardous sound levels results in the development of occupational noise-induced hearing loss (NIHL), a serious physical, psychological, and social problem. NIHL can be distinguished from aging and medical factors, diagnosed, and prevented.

The National Institute for Occupational Safety and Health (NIOSH) has identified the ten leading work-related diseases and injuries in the publication, ''Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries, Part 2.'' According to NIOSH, NIHL is among these ''top ten'' diseases and injuries.

For many years, the risk of acquiring an NIHL was accepted as an inevitable consequence associated with mining occupations. Miners use mechanized equipment and work under conditions that often expose them to hazardous sound levels. But MSHA standards, OSHA standards, military standards, and others around the world have been established in recognition of the controllability of this risk. Quieter equipment, isolation of workers from noise sources, and limiting worker exposure times are among the many well accepted methods now used to reduce the costly incidence of NIHL.

NIHL can be temporary or permanent depending on the intensity and duration of the noise exposure. Temporary hearing loss results from short term exposures to noise, with normal hearing returning after a period of rest. Generally, prolonged exposure to noise over a period of several years causes permanent damage to the auditory nerve: the higher the sound level the more rapid the loss. The loss may be so gradual, however, that a person may not realize that he or she is becoming impaired until a substantial amount of hearing acuity is lost.

Damage to the inner ear hair cells and auditory nerve makes it difficult to hear as well as understand speech. This damage is irreversible. Although people with NIHL sometimes can benefit from the use of a hearing aid, the aid can never ''correct'' a hearing loss the way eyeglasses usually can correct impaired vision. That is because hearing aids primarily amplify sound without making it clearer or less distorted. Also, they amplify the unwanted noise as well as the wanted speech signals.

People with significant NIHL have difficulty with the perception of speech. They are often frustrated by missing information that is vital for social or vocational functioning, and can produce workplace safety hazards. Also, people around them need to speak louder, and more clearly to be understood. In addition, background noise has a much more disruptive effect on hearing-

impaired individuals because they are less able to differentiate between the wanted signal and the unwanted background noise.

There is a wealth of information on the relationship between noise exposure and its auditory (hearing loss) and non-auditory (physiological and psychosocial) effects.

Numerous studies are available which describe the effects of noise on hearing as a function of sound level and duration. Dose-response relationships have been well established for noise equal to or greater than average sound levels of 85 dBA (see, e.g., Lempert and Henderson, 1973).

Although the non-auditory effects of noise are more difficult to identify, document, and quantify than is hearing loss, recent laboratory and field studies have implicated noise as a causative factor in cardiovascular problems (Tomei et al., 1992 and Lercher et al., 1993) and other illnesses such as hypertension (Talbott, 1990, and Jansen, 1991). Decreasing the noise exposure from greater than 85 dBA to less than 85 dBA significantly improved both the psychological and physiological stress reactions (Melamed and Bruhis, 1996). However, these studies of health effects have not been conclusive.

In Earlog 6, Berger (1981) discussed the adverse non-auditory effects of noise exposure. He suggests that effective hearing conservation programs may not only prevent NIHL, but also improve general employee health and productivity.

Schmidt, et al. (1980) studied injury rates among workers in a North Carolina cotton manufacturer exposed to noise ranging from 92 to 96 dBA. During the ten year time period studied, a significant reduction in injury rates was observed for those workers who were in an HCP, compared to those who were not.

Safety risks can specifically be created because workers harmed by NIHL can no longer hear safety signals. Most people with an NIHL have reduced hearing acuity at the higher frequencies and lose their ability to distinguish consonants on which the intelligibility of speech depends. For example, they would have difficulty in distinguishing between ''fish'' and ''fist.''

Although MSHA recognizes that non-auditory effects of noise can be significant, they are difficult to quantify; by contrast, the auditory risks have a well-established dose-response relationship, and thus provide a solid foundation on which to base regulatory action. The Agency believes that reducing sound levels and protecting miners from hazardous noise exposures will also reduce the non-auditory effects of noise.

Definition of Material Impairment

Section 101(a)(6) of the Mine Safety and Health Act provides that in setting standards to protect workers from the risks of harmful physical agents, the Secretary ''shall set standards which most adequately assure on the basis of the best available evidence that no miner will suffer material impairment of health or functional capacity even if such miner has regular exposure to the hazards dealt with by such standard for the period of his working life.''

While the material impairment to which the law refers is material impairment of ''health or functional capacity'', the term material impairment in the literature on noise risk generally refers to a level of harm which is considered handicapping or even disabling—a 25 dB hearing level (deviation from audiometric zero)—so this had to be the basis of MSHA's estimates of the risk of material impairment. The scientific community has actually utilized over time at least three different definitions of what constitutes ''material impairment'' in the case of NIHL. All use a 25 dB hearing level, but each definition has used a different set of frequencies. Of these, the Agency believes the one developed in 1972 by NIOSH and subsequently used by OSHA is most appropriate of the three for evaluating the risks faced by miners of developing disabling NIHL. The OSHA/NIOSH definition of material impairment of hearing is a 25 dB hearing level averaged over 1000, 2000, and 3000 Hertz (Hz) in either ear. As noted in the History section of this preamble, the Agency is aware that NIOSH is currently considering a new definition that also includes hearing loss at 4000 Hz; but until such an approach is peer reviewed and approved, MSHA believes it is not an appropriate basis for evaluating risk.

Background

Ideally, a definition of material impairment based solely upon audiometric tests that measure individual ability to understand speech would best characterize the debilitating effects of an NIHL. Unfortunately, these tests are complicated, not well standardized, and therefore seldom used to determine hearing impairment. For these reasons, most definitions of impairment are based solely on pure tone audiometry.

Pure tone audiometric tests utilize an audiometer to measure the hearing level threshold of an individual by determining the lowest level of discrete frequency tones that the individual can hear. The test procedures for conducting pure tone audiometry are relatively simple, widely used, and have been standardized. Although there is little debate among the scientific community about the usefulness of pure tone audiometry in assessing hearing loss, some disagreement exists as to the hearing level where hearing impairment begins and the range of audiometric frequencies to use in making the assessment.

In issuing its Hearing Conservation Amendment (46 FR 4078), OSHA defined hearing impairment as exceeding a 25 dB ''hearing level'' averaged over 1000, 2000, and 3000 Hertz (Hz) in either ear. Hearing level is the deviation in hearing acuity from audiometric zero, the lowest sound pressure level audible to the average normal-hearing young adult. Positive values indicate poorer hearing acuity than audiometric zero, while negative values indicate better hearing. Because OSHA based its definition on a 1972 recommendation by NIOSH (1972), MSHA refers to this definition as the OSHA/NIOSH criteria for hearing impairment.

NIOSH specifically developed its definition of hearing impairment for understanding speech under everyday (noisy) conditions. NIOSH concluded that ''the basis of hearing impairment should be not only the ability to hear speech, but also to understand speech,'' and this is best predicted by the hearing levels at 1000, 2000, and 3000 Hz.

When OSHA initially published its Hearing Conservation Amendment, most medical professionals used the 1959 criteria developed by the American Academy of Ophthalmology and Otolaryngology (AAOO), a subgroup of the American Medical Association (AMA). This criteria (AAOO 1959) defined hearing impairment as exceeding a 25 dB hearing level, referenced to audiometric zero, averaged over 500, 1000, and 2000 Hz in either ear (1959).

The American Academy of Otolaryngology Committee on Hearing and Equilibrium and the American Council of Otolaryngology Committee on the Medical Aspects of Noise (AAO–HNS) has since modified the 1959 criteria by adding the hearing level at 3000 Hz to the hearing levels at 500, 1000, and 2000 Hz (1979).

Unlike the OSHA/NIOSH criteria, the AAOO 1959 and AAO–HNS 1979 criteria are for all types of hearing loss, including noise-induced hearing loss (NIHL), and were mainly designed for hearing speech under relatively quiet conditions.

In its ANPRM, MSHA asked for comments on a definition of hearing impairment. Many commenters either directly or indirectly endorsed the OSHA/NIOSH definition of hearing impairment. One commenter suggested defining a significant material impairment as an average permanent threshold shift of 25 dB or more at 1000, 2000, 3000, and 4000 Hz in either ear. Other commenters supported the AAO–HNS 1979 criteria as the level where impairment begins. (Several commenters suggested that MSHA separately address a definition of hearing loss for reporting purposes; this has been done, as discussed in part III of this preamble in connection with proposed § 62.190(b).)

Discussion

MSHA has determined that with respect to mine safety and health, any definition of material impairment of hearing should relate to a permanent, measurable loss of hearing which, unchecked, will limit the ability to understand speech, as it is spoken in everyday social (noisy) conditions. This is because speech comprehension is essential for mine safety.

Measures of hearing impairment depend upon the frequencies used in calculating the hearing impairment. At relatively low sound levels (between 80 dBA and 90 dBA) the hearing loss is confined to the higher audiometric frequencies. In order to show the effect of noise below 90 dBA on hearing, inclusion of test frequencies above 2000 Hz is necessary. MSHA agrees with the many comments and studies cited to show that high frequency hearing is critically important for the understanding of speech and that every day speech is sometimes distorted and often takes place in noisy conditions.

Therefore, MSHA has determined that for purposes of mine safety and health, 3000 Hz should be included in any definition of material impairment. In addition, 500 Hz should be excluded from any definition, since it is not as critical for understanding speech and least affected by noise. Of the three generally utilized definitions of noise—the AAOO 1959, the AAO–HNS 1979, and the OSHA/NIOSH criteria—only the latter meets this test.

All three of the aforementioned definitions of noise use a 25 dB hearing level. As noted previously, this level of hearing loss relative to audiometric zero is actually well beyond that at which there is harm to health and also well beyond that at which workers suffer a loss of functional capacity. Nevertheless, this is the measure used in almost all of the studies of risk of noise exposure that have been done. This constrains the definition of material impairment the Agency utilizes to evaluate the available risk data.

Accordingly, solely for the purposes of evaluating the significance of the available risk studies for miners, MSHA is adopting the OSHA/NIOSH criteria, a 25 dB hearing level averaged over 1000, 2000, and 3000 Hertz (Hz) in either ear, as its definition of material impairment.

With respect to risk evaluations, the number of persons meeting the definition of impairment in any noise-exposed population will be higher under the OSHA/NIOSH criteria than under the other criteria (AAOO 1959 and AAO–HNS 1979). This is because noise does not affect hearing acuity equally across all frequencies. Typically, NIHL occurs first at 4000 Hz, then progresses into the lower and higher frequencies. The AAOO 1959 criteria is weighted toward the lower frequencies and was developed to determine an individual's ability to communicate under quiet conditions. Recognizing that an individual's ability to hear speech in a noisy environment depends upon that person's ability to hear sounds in the higher frequency range, the AAO–HNS added 3000 Hz to the frequencies used in the AAOO 1959 criteria. The impact of this modification is that the number of persons meeting the impairment criteria in any noise-exposed population will be higher under the AAO–HNS 1979 criteria than under the AAOO 1959 criteria. With the elimination of the hearing level at 500 Hz from the frequency range used, the OSHA/NIOSH definition is weighted even more toward the higher frequencies than the AAO–HNS 1979 criteria, and thus even more are determined to be impaired.

Moreover, selection of a criterion places some limitations on direct comparisons of data sources available for risk assessment. Data compiled using one definition of impairment are not readily translatable to the others. Since there is no reliable mathematical relationship among the three criteria for hearing impairment, it is not possible to accurately predict the impact on a population using the other two criteria when only the impact of one criterion is known. The ideal way to convert from one hearing impairment criterion to another would be to use the hearing level data for individual frequencies (raw data), if still available from the individual audiograms. It is also possible to crudely estimate the impact of one criterion to another provided that summary data on individual frequencies are available. Unfortunately, most of the data necessary to complete such conversions are no longer available.

In the discussion of risk that follows in the next section of this preamble, sources of data based on all three definitions of impairment are presented, so this caveat about translation needs to be kept in mind. As it turns out, however, data using all three definitions tend to demonstrate the same result.

Risk of Impairment

The studies of risk reviewed in this section consistently indicate that the risk of developing a material impairment (as defined in the prior section for purposes of this discussion) becomes significant over a working lifetime when workplace exposure exceeds average sound levels of 85 dBA. The data indicate that while lowering exposure from an average sound level of 90 dBA to one of 85 dBA does not eliminate the risk, it does reduce the risk by approximately half.

Measuring Risk

It is not possible to determine the risk to individual miners of particular levels of noise. Some miners will suffer harm long before other miners from the same level of noise, and it is not possible to measure susceptibility in advance. Risks can, however, be determined for entire populations. According to Melnick (1982), professor emeritus of audiology at Ohio State University:

> Experts agree that information is available for deriving the relationship of noise exposure to hearing loss. This information serves as the basis for development of damage risk criteria. * * * The relationship of noise to hearing is in the scientific domain. The decisions inherent in development of damage risk criteria are social, political, and economic. Damage risk criteria are statistical concepts. Use of these criteria should be limited to considerations of populations. Damage risk criteria are not appropriate for use with individuals no matter how tempting such an application might be.

The probability of acquiring a ''material impairment'' of hearing in a given population can be determined by extrapolating from data obtained from a test population exposed to the same sound levels. Three methods are generally used to express this population risk:

(1) the hearing level of the exposed population;

(2) the percent of an exposed population meeting the selected criteria; and

(3) the percent of an exposed population meeting the selected criteria minus the percent of a non-noise exposed population meeting the same criteria, provided both populations are

similar except for the occupational noise exposure.

The latter of these expressions is more commonly known as ''excess risk''. The excess risk method separates that percentage of the population expected to develop a hearing impairment from occupational noise exposure from that percentage expected to develop an impairment from non-occupational causes—for example, the normal aging process or medical problems. Hearing impairment risk data will be presented here using the excess risk method, because MSHA has concluded that this method provides the most accurate picture of the risk of hearing loss resulting from occupational noise exposure. OSHA also used this method in quantifying the degree of risk in the preamble to its Hearing Conservation Amendment.

Although studies of hearing loss consistently indicate that increased noise exposure (either level or duration) results in increased hearing loss, the reported risk estimates of occupational NIHL can vary considerably from one study to another. As noted in the prior section, the definition of ''material impairment'' used plays a role. But two additional factors can be involved: the screening of the control group (non-noise exposed group), and the threshold used to define that group.

Some researchers do not screen their study and control populations, while others use a variety of different screening criteria. Theoretically, screening would not have a significant impact on the magnitude of occupational NIHL experienced by given populations as long as the same criteria are used to screen both the noise and the non-noise populations being compared. However, when considering whether the subjects have exceeded an established definition of material impairment, failure to take into account any non-occupational noise exposure and/or presbycusis (loss of hearing acuity due to aging) can have a profound effect on the estimates of hearing acuity of an exposed population. For example, if both the exposed and control populations are screened to eliminate persons with a history of military exposure, use of ototoxic medicines, noisy hobbies, conductive hearing loss from acoustic trauma or illness, etc., the excess risk would be significantly different from that determined using unscreened populations.

The data presented here all use the same threshold. The threshold refers to that average sound level below which no adverse effects from noise exposure are expected to occur. Although researchers Kryter (1970) and Ambasankaran et al. (1981) have reported hearing loss from exposure to average sound levels below 80 dBA, most believe that the risk of developing a material impairment of hearing from exposure to such levels over a working lifetime is negligible. Accordingly, almost all noise risk studies consider the population exposed only to average levels of noise below 80 dBA as a ''non-noise exposed'' control group. In turn, this becomes the baseline from which the excess risk of being exposed to noise at higher levels is measured. When OSHA evaluated the risk of hearing loss for its hearing conservation amendment, it took the position that it was appropriate to consider the non-noise exposed control group to those exposed to sound levels below 80 dBA. MSHA, for the purpose of this proposal, agrees with OSHA's assessment.

As a result of these variations, the data available present a range of risk estimates. As discussed later in the ''Conclusions'' section of this part, for purposes of estimating the risks to miners, the Agency has determined it should properly utilize the range of risk in those studies based upon the OSHA/NIOSH definition of material impairment. As noted in that discussion, however, even using the full range of the data presented here would lead to a similar conclusion.

Review of Study Data

Table 1 is taken from the preamble to OSHA's Hearing Conservation Amendment (46 FR 4084). It displays the percentage of the industrial population expected to develop a hearing impairment meeting the AAOO 1959 criteria if exposed to the specified sound levels over a working lifetime (40 years). This is a compilation of data developed by the U.S. Environmental Protection Agency (EPA) in 1973, the International Standards Organization (ISO) in 1975, and NIOSH in 1972. EPA, ISO, and NIOSH developed their risk assessments using the AAOO 1959 criteria because this was the format used by the original researchers in presenting their data. OSHA's risk table was developed primarily from studies of noise exposed populations in many sectors of general industry.

TABLE II–1.—OSHA RISK TABLE

Sound level (dBA)	Excess risk (%)			
	ISO (1975)	EPA	NIOSH	Range
80	0	5	3	0–5
85	10	12	15	10–15
90	21	22	29	21–29

As seen in Table II–1, the excess risk of material impairment after a working lifetime at an average noise exposure of 80 dBA is low, at an average noise exposure of 85 dBA ranges from 10–15%, and at an average noise exposure of 90 dBA it ranges from 21–29%. Table II–2 presents further information on the risk assessments developed by NIOSH in their criteria document (1972), one portion of which was included in Table II–1. In Table II–2, data are based on both the AAOO 1959 criteria and the OSHA/NIOSH criteria.

TABLE II–2.—NIOSH RISK TABLE

Sound level (dBA)	Excess risk (%)	
	OSHA/NIOSH	AAOO 1959
80	3	3
85	16	15
90	29	29

As shown in Table II–2, NIOSH's risk assessment (1972) found little difference using OSHA/NIOSH criteria when compared to AAOO 1959 criteria. However, as previously noted, NIOSH recommends using the OSHA/NIOSH criteria for making risk assessments.

Several researchers have commented on how adjustments to the criteria used would affect such excess risk figures. Suter (1988) estimates that the excess risk would be somewhat higher if 500 Hz was excluded and 3000 Hz was included in the definition of material impairment. Sataloff (1984) also reported on the effect of adding 3000 Hz into the impairment criteria. He recalculated the effect of including hearing loss at 3000 Hz to the AAOO 1959 definition of hearing impairment and found that the prevalence of hearing impairment increased considerably. After 20 years of exposure to intermittent noise that peaked at 118 dBA, 3% of the workers experienced hearing impairment according to the AAOO 1959 definition of hearing impairment. If the AAO–HNS 1979 definition is used, the percentage increases to 9%. Royster et al. (1978) confirmed that the exclusion of 500 Hz and the inclusion of 3000 Hz increased the number of hearing impaired individuals during a study of potential

workers' compensation costs for hearing impairment. Using an average hearing loss of 25 dB as the criteria, Royster found that 3.5% of the industrial workers developed a hearing impairment according to AAOO 1959, 6.2% according to AAO–HNS 1979, and 8.6% according to OSHA/NIOSH.

Table II–3, II–4 and II–5 display another set of data on the working lifetime risk of material impairment, based upon the three different criteria commonly used for defining material impairment. Table II–3 is based on the AAO 1959 criteria, Table II–4 is based on the AAO–HNS 1979 criteria, and Table II–5 is based on the OSHA/NIOSH criteria. MSHA constructed these tables based on data presented in Volume 1 of the Ohio State Research Foundation report (Melnick et al., 1980) commissioned by OSHA. The hearing level data, used to construct the tables, were taken from summary graphs in the report. The noise exposed population is 65 years old with 40 years of noise exposure. The control group was not screened as to the cause of any hearing loss; therefore, the high level of non-occupational hearing loss may underestimate the excess risk from occupational noise exposure. The researchers added the noise-induced permanent threshold shift component to the control data. Noise-induced permanent threshold shift (NIPTS) is the actual shift in hearing level only due to noise exposure after corrections.

As expected, the three tables produce different results, reflecting that, for any given population, the excess risk for material impairment will be greater using the AAO–HNS 1979 criteria than using the AAOO 1959. Likewise, the excess risk for material impairment will be greater using the OSHA/NIOSH criteria than using the AAO–HNS 1979. All three tables produce a smaller excess risk than did the data presented in Table II–1.

TABLE II–3.—RISK OF IMPAIRMENT USING AAOO 1959 DEFINITION OF IMPAIRMENT USING MELNICK, ET AL., 1980 DATA

Exposure	Percent with impairment	Excess risk (%) with noise exposure
Non-noise	26.8	0.0
80 dBA	26.8	0.0
85 dBA	27.8	1.0
90 dBA	31.4	4.6

TABLE II–4.—RISK OF IMPAIRMENT USING AAO–HNS 1979 DEFINITION OF IMPAIRMENT USING MELNICK, ET AL., 1980 DATA

Exposure	Percent with impairment	Excess risk (%) with noise exposure
Non-noise	41.6	0.0
80 dBA	41.8	0.2
85 dBA	44.4	2.8
90 dBA	50.0	8.4

TABLE II–5.—RISK OF IMPAIRMENT USING OSHA/NIOSH DEFINITION OF IMPAIRMENT USING MELNICK, ET AL., 1980 DATA

Exposure	Percent with impairment	Excess risk (%) with noise exposure
Non-noise	48.5	0.0
80 dBA	48.7	0.2
85 dBA	51.5	3.0
90 dBA	57.9	9.4

Tables II–6 and II–7 present data derived by Melnick in *Forensic Audiology* (1982) for damage risk due to noise exposure. These tables use the AAO–HNS 1979 criteria. In these tables, the population is 60 years old with 40 years of exposure to the specified sound levels. In both tables, the data represent NIPTS (noise induced permanent threshold shift) calculated by Johnson, but the screening used in the two tables is different. Melnick's data in Table II–6 is based upon the screened presbycusis data (i.e. screened for non-occupational hearing loss) of Robinson and Passchier-Vermeer, whereas Table II–7 is based on unscreened non-occupational hearing loss data from the 1960–62 U.S. Public Health Survey.

Overall, the excess risk information presented in these tables is closer to that in Table II–1 than to that in Tables II–3, II–4, and II–5, but still different. Tables II–6 and II–7 directly illustrate the effect of screening populations in determining excess risk due to occupational noise exposure. As seen in these tables, the percent with impairment is greater in the table constructed with an unscreened population as the base.

TABLE II–6.—RISK OF IMPAIRMENT USING PRESBYCUSIS DATA OF PASSCHIER-VERMEER AND ROBINSON

Exposure	Percent with impairment	Excess risk (%) with noise exposure
75 dBA	3	0
80 dBA	5	2
85 dBA	9	6
90 dBA	21	18

TABLE II–7.—RISK OF IMPAIRMENT USING NON-OCCUPATIONAL HEARING LOSS DATA OF PUBLIC HEALTH SURVEY

Exposure	Percent with Impairment	Excess risk (%) with noise exposure
75 dBA	27	0
80 dBA	29	2
85 dBA	33	6
90 dBA	40	13

Chart ER1 displays the results of the various models. It should be noted that both the P/V/Robinson (data from Table II–6) and the PHS model (data from Table II–7) used the AAO–HNS 1979 criteria.

As noted in the History section of this preamble, the Agency is aware that NIOSH is currently working on revising its estimates using a different model and taking hearing loss at an additional frequency into account; but until such an approach is peer reviewed and finalized, MSHA has concluded it should not be considered here.

As illustrated by Chart ER1, the exact numbers of those at risk varies with the study—because of the definition of material impairment used, and because of the selection and threshold of the control group. Notwithstanding these differences, the data consistently demonstrate three points: (1) the excess risk increases as noise exposure increases; (2) there is a significant risk of material impairment of hearing loss for workers exposed over their working lifetimes to average sound levels of 85 dBA; and (3) lowering the exposure from average sound levels of 90 dBA to average sound levels of 85 dBA reduces the excess risk of developing a material impairment by approximately half.

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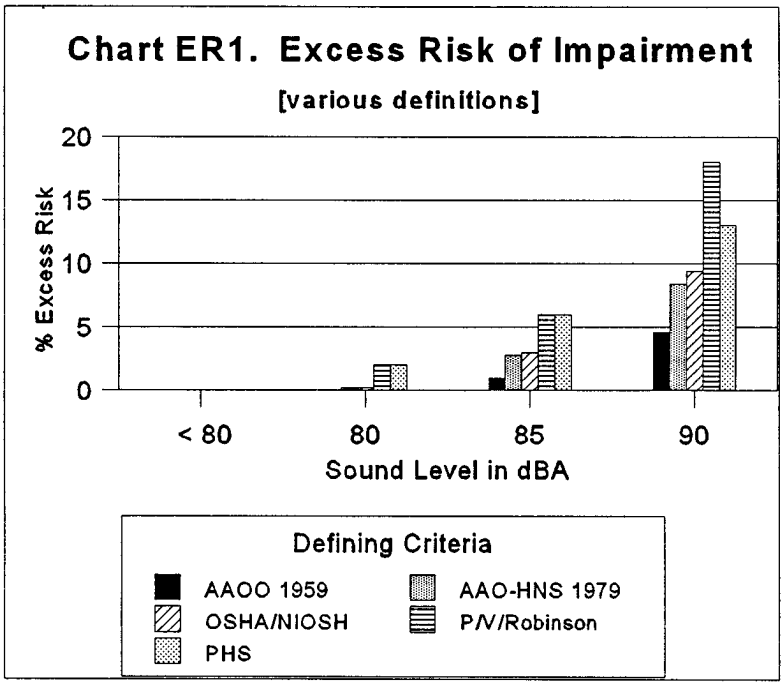

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Related Studies of Worker Hearing Loss

There is a large body of data on the effects of varying industrial sound levels on worker hearing. Some of these studies specifically address the mining industry; moreover, MSHA has determined that regardless of the industry in which the data were collected, exposures to similar sound levels will result in similar degrees of material impairment in the workers. These studies are supportive of the conclusions reached in the previous section about noise risks at different sound levels.

OSHA's 1981 preamble to its Hearing Conservation Amendment referred to studies conducted by Baughn, Burns and Robinson, Martin, et al., and Berger et al.

Baughn (1973) studied the effects of average noise exposures of 78 dBA, 86 dBA, and 90 dBA on 6,835 industrial workers employed in Midwestern plants producing automobile parts. Noise exposures for these workers were measured for 14 years and, through interviews, exposure histories were estimated as far back as 40 years. The control and the noise-exposed groups were not screened for anatomical abnormalities of the ear.

Baughn used his data to provide estimates of the hearing levels of workers exposed to 80 dBA, 85 dBA, and 92 dBA and extrapolated the exposures up to 115 dBA. Based upon the analysis, the researcher constructed an idealized graph which illustrated that 43% of 58-year old workers exposed for 40 years to noise at 85 dBA would meet the AAOO 1959 criteria for hearing impairment. However, 33% of an identical non-noise exposed population would be expected to meet the same impairment criteria. The excess risk from exposure to noise at 85 dBA, therefore, would be 10%. Using the same procedure, the excess risk for 80 dBA is 0% and for 90 dBA it is 19%.

Burns and Robinson (1970) studied the effects of noise on 759 British factory workers exposed to average sound levels between 75 dB and 120 dB with durations ranging between one month and 50 years. The control group consisted of 97 non-noise exposed workers. Thorough screening removed the workers with exposure histories which were not readily quantifiable, exposure to gunfire, ear disease or abnormality, and language difficulty.

For this study, Burns and Robinson analyzed 4,000 audiograms and found that the hearing levels of workers exposed to low sound levels for long periods of time were equivalent to other workers exposed to higher sound levels for shorter durations. From the data, the researchers developed a mathematical model that predicts hearing loss between 500 Hz and 6000 Hz in certain segments of the exposed population. Using Burns and Robinson's mathematical model, MSHA constructed Chart ER2. The chart shows that a noise exposure of 85 dBA over a 40-year career is clearly hazardous to the hearing acuity of 60-year-old workers.

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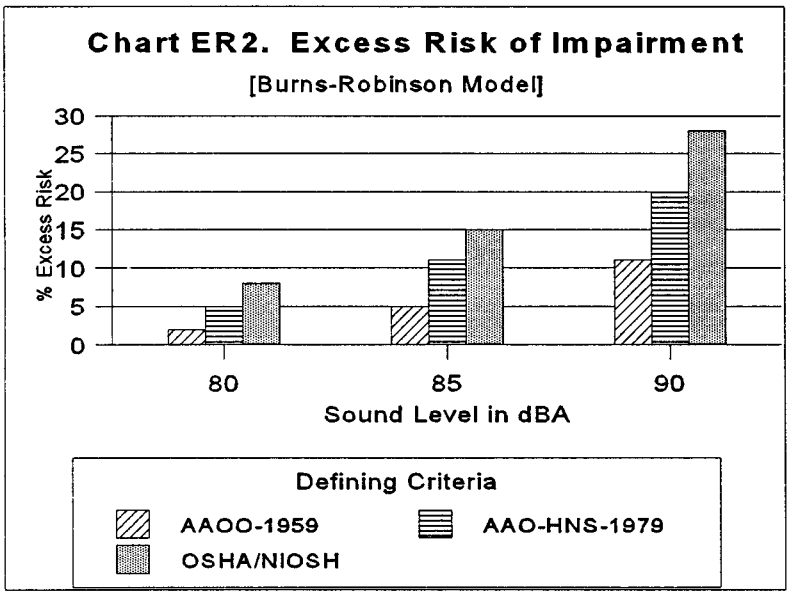

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Martin et al. (1975) studied the prevalence of hearing loss in a group of 228 Canadian steel workers, ranging in age from 18 to 65 years of age, by comparing them to a control group of 143 office workers. The researchers reported that the risk of hearing impairment (average of 25 dB at 500, 1000, and 2000 Hz) increases significantly between 85 dBA and 90 dBA. Up to 22% of the population would be at risk of incurring a hearing impairment with a 90 dBA PEL compared to 4% with an 85 dBA PEL. Both the noise exposed and the control groups were screened to exclude those workers with non-occupational hearing loss.

Berger, Royster, and Thomas (1978) studied 42 male and 58 female workers employed at an industrial facility. The study included a control group of 222 persons that was not exposed to occupational noise. Of the 322 individuals included in the study, no one was screened for exposures to non-occupational noise from past military service, farming, hunting, or shop work, since these exposures were common to all. The researchers found that exposure to a daily steady-state L_{eq} of 89 dBA for 10 years caused a measurable hearing loss at 4000 Hz. According to the researchers, the measurable loss was in close agreement with the predictions of Burns and Robinson, Baughn, NIOSH, and Passchier-Vermeer.

Passchier-Vermeer (1974) reviewed the results of eight field investigations on hearing loss among 20 groups of workers. About 4,600 people were included in the analysis. The researcher concluded that the limit of permissible noise exposure (defined as the maximum level which did not cause measurable noise-induced hearing loss, regardless of years of exposure) was shown to be 80 dBA. Furthermore, the researcher found that noise exposures above 90 dBA caused considerable hearing loss in a large percentage of employees and therefore, recommended that noise control measures be instituted at this level. The researcher also recommended that audiometric testing be implemented when the noise exposure exceeds 80 dBA.

NIOSH (Lempert and Henderson, 1973) published a report in which the dose-response relationship for noise-induced hearing loss was described. NIOSH studied 792 industrial workers whose average daily noise exposures were 85 dBA, 90 dBA, and 95 dBA. The noise-exposed workers were compared to a group of controls whose noise exposures were lower than 80 dBA. The subjects ranged in age from 17 to 65 years old. The exposures were primarily to steady-state noise but the exposure levels fluctuated slightly in each category. Both the noise-exposed and control groups were screened to exclude those exposed to gunfire as well as those who showed some sign of ear disease or audiometric abnormality. The report clearly shows that workers whose noise exposures were 85 dBA experienced more hearing loss than the controls. As the noise exposures increased to 90 dBA and 95 dBA, the magnitude of the hearing loss increased.

NIOSH (1976) published the results from a study on the effects of prolonged exposure to noise on the hearing acuity of 1,349 coal miners. From this study, NIOSH concluded that coal miners were losing their hearing acuity at a faster rate than would be expected from the measured environmental sound levels. While the majority of noise exposures were less than a TWA_8 of 90 dBA, the measured hearing loss of the older coal miners was indicative of noise exposures between 90 dBA and 95 dBA. Only 12% of the noise exposures exceeded a TWA_8 of 90 dBA. NIOSH, however, offered as a possible explanation that some miners are exposed to ''very intense noise'' for a sufficient number of months to cause the hearing loss.

Coal miners in the NIOSH (1976) study had a greater percent of impairment than the non-occupational exposed group (control group) at each age level. Using OSHA/NIOSH definition of impairment, 70% of 60-year-old coal miners were impaired while only a third of the control group were impaired. This would correspond to an excess risk of 37%.

NIOSH also sponsored a study, conducted by Hopkinson (1981), on the prevalence of middle ear disorders in coal miners. As part of this study, the hearing acuity of 350 underground coal miners was measured. The results of this study corroborated the results of the earlier NIOSH study on the hearing acuity of underground coal miners. In both studies the measured median hearing levels of the miners were the same. However, the study did not present statistics on the percent of miners incurring a hearing impairment nor the job classification of the miners.

Studies of Harm at Lower Sound Levels

As our knowledge about the effects of noise increases, there is increased need

to examine data that focuses on the harm that can occur at lower sound levels. This section reviews some of the studies, particularly those of workers from other countries, available in this regard.

The most recent data are derived using the International Standards Organization's publication ISO 1999 (1990). The information in that publication can be used to calculate the mean and various percentages of a population's hearing levels. The noise exposures for the population can range between 75 dBA and 100 dBA. Table II–8 presents the hearing level of a 60-year-old male exposed to noise for 40 years. The noise induced hearing permanent threshold shift was combined with presbycusis values to determine the total hearing loss. The presbycusis values were those from an unscreened population. The unscreened population is believed to more accurately represent the mining population since people with nonoccupational hearing loss would not be excluded from becoming miners.

TABLE II–8.—HEARING LEVEL FOR SELECTED NOISE EXPOSURES

Sound Level in dBA	Hearing level in dB			
	500 Hz	1000 Hz	2000 Hz	3000 Hz
80	12	6	10	30
85	12	6	11	33
90	12	6	16	42

Information about the effects on hearing of lower noise exposures can be particularly valuable in directing attention to the possibility of identifying subpopulations particularly sensitive to noise. The Committee on Hearing, Bioacoustics, and Biomechanics of the National Research Council (CHABA) (1993) reviewed the scientific literature on hazardous exposure to noise. The report, reaffirming many of the earlier findings of the Committee, suggests that exposures below 76 dBA to 78 dBA are needed to prevent a NIHL based upon temporary threshold shift (TTS) studies; moreover, the report suggests that the sound level be less than 85 dBA, and possibly less than 80 dBA, to guard against any permanent hearing loss at 4000 Hz based upon field studies. But of particular interest is the suggestion that therapeutic drugs, such as aminoglycoside antibiotics and salicylates, can interact synergistically with noise to yield more hearing loss than would be expected by either stressor. Given the increasing use of salicylates (aspirin) in heart maintenance regimens, the potential synergistic effect may warrant further study.

Few current studies of unprotected U.S. workers exposed to a TWA_8 between 85 and 90 dBA are available because the OSHA hearing conservation standard requires some protection at those levels for most industries. The difficulty in constructing new retrospective studies of U.S. workers has been noted by Kryter (1984) in his chapter on Noise-Induced Hearing Loss and Its Prediction. He believes that the retrospective studies of Baughn, Burns and Robinson, and the U.S. Public Health Service are the best available on the subject of NIPTS. Regarding current retrospective studies he states:

> Furthermore, imposition of noise control and hearing conservation programs in many industries in many countries over the past 10 years or so make somewhat remote the possibility of performing a meaningful retrospective study of the effects in industry of noise on the unprotected ear.

Kryter included a formula for deriving the effective noise exposure level for damage to hearing. This was used to determine, from a population of workers, NIPTS at different percentiles of sensitivity at various audiometric test frequencies.

Studies of workers from other countries can provide information of particular value in assessing the consequences of workplace noise exposure between 85 dBA and 90 dBA. MSHA has determined that while differences in socioeconomic factors (e.g., recreational noise exposure, use of ototoxic medicines, otitis media) make it difficult to directly apply the results of studies of workers from other countries to quantify the risk for U.S. workers, they can be used to establish the existence of a risk in the 80 to 90 dBA range.

Rop, Raber, and Fischer (1979) studied the hearing loss of 35,212 male and female workers in several Austrian industries, including mining and quarrying. The researchers measured the hearing levels of workers exposed to sound levels ranging from less than 80 dBA up to 115 dBA, and arranged them into eight study groups based upon average exposures. They assumed that exposure to sound levels less than 80 dBA did not cause any hearing loss and workers exposed to these levels were assigned to the control group.

Rop et al. reported that workers with 6 to 15 years of exposure at 85 dBA had significantly worse hearing than the control group. For the five groups exposed between 80 dBA and 103.5 dBA, hearing loss tended to increase steadily during their careers, but leveled off after 15 years. However, for workers exposed to sound levels above 103.5 dBA, hearing loss continued to increase beyond 15 years.

Using the data collected during the study, Rop et al. developed a statistical method for predicting hearing loss. The researchers predicted that 20.1% of the 55-year old males in the control group with 15 years of work experience would incur hearing loss. For a comparable group of males with exposures at 85 dBA the risk increased to 41.6%; at 92 dBA the risk increased to 43.6%; and at 106.5 dBA the risk increased to 72.3%. Rop et al. concluded that exposure to sound levels at or above 85 dBA damaged workers' hearing.

Schwetz et al. (1980) reported on a study of 25,000 Austrian workers. The study concluded that the workers exposed to sound levels between 85 dBA and 88 dBA experienced greater hearing loss than workers exposed to sound levels less than 85 dBA. Because of this, Schwetz recommended 85 dBA as the critical intensity (i.e., PEL). Furthermore, the study concluded that a lack of hearing recovery occurs at 85 dBA which is the ultimate cause of noise-induced hearing loss (NIHL).

Stekelenburg (1982) calculated the hearing loss due to presbycusis according to Spoor and due to noise according to Passchier-Vermeer. Based upon these calculations, Stekelenburg suggested that 80 dBA be the acceptable level for noise exposure over a 40 year work history. At this exposure, Stekelenburg calculates that impaired social hearing due to noise would be expected in 10% of the population.

Bartsch et al. (1989) studied 537 textile workers. These researchers defined hearing loss of social importance as a 40 dB hearing level at 3000 Hz. The researchers found that hearing loss resulting from exposures below 90 dBA mainly occurs at frequencies above 8000 Hz (these frequencies are not normally tested during conventional audiometry), and so concluded that this hearing loss was not of ''social importance.'' Nevertheless, they recommended a hearing loss risk criterion of 85 dBA be used to protect the workers' hearing.

These results are generally consistent with those of U.S. workers. MSHA would, however, note its disagreement with the characterization of the amount of hearing loss not being of ''social importance'' as expressed in the Bartsch et. al (1989) study. The Agency has concluded that a person will encounter hearing difficulty before their hearing level reaches 40 dB at 3000 Hz. Studies, discussed earlier in *Definition of Material Impairment,* address the importance of having good hearing

acuity at 3000 Hz in order to adequately understand speech in everyday noisy environments.

Reported Hearing Loss Among Miners

To confirm the magnitude of the risks of NIHL among miners, MSHA examined evidence of reported hearing loss among miners—audiometric data collected over the years tracking hearing acuity among miners, the comments received in response to the Agency's ANPRM, reports of hearing loss by mine operators pursuant to 30 CFR part 50, and workers' compensation data. Such data could provide a quantitative determination of material impairment.

With respect to audiometric data, MSHA asked NIOSH to examine a set of data on coal miners. The analysis (Franks, 1996) supports the data from scientific studies. It indicates that 90% of these coal miners have a hearing impairment by age 50 as compared with only 10% of the general population. Further, Franks stated that miners, after working 20 to 30 years, could find themselves in life threatening situations since safety signals and ''roof talk'' could go unheard. (For the purposes of the analysis, NIOSH used the definition of hearing impairment it is now considering, an average 25 dB hearing level at 1000, 2000, 3000, and 4000 Hz; MSHA conducted its own analysis of the data without the 4000 Hz, and the results are generally consistent with those of NIOSH).

This section also reviews several other sources of data that might provide direct information about the risks of hearing loss to miners: the comments received in response to the Agency's ANPRM, the reports of hearing loss provided to the Agency by mine operators pursuant to 30 CFR part 50, and workers' compensation data. In each case, the available data are too limited to draw any conclusions. The Agency is requesting the public to provide further information along these lines.

Audiometric Data Bases

Audiometric testing is not currently required in metal and nonmetal mining and is only required when an overexposure to noise is determined in coal mining. Certain mining companies conduct routine audiometric testing on their employees, but the results of these tests are confidential and are not published for public use. In addition, summary reports of these audiometric tests are generally not available.

MSHA, however, has obtained an audiometric data base consisting of 20,021 audiograms conducted on 3,433 individual coal miners, in connection with its ongoing efforts to assess the effectiveness of the current standards in protecting miner health. The audiometric evaluations were conducted between 1971 and 1994 with the bulk of the audiograms conducted during the latter years.

NIOSH (Franks, 1996) has analyzed this data base. Each audiogram was reviewed for validity and NIOSH audiologists directly reviewed more than 2,500 audiograms. The review reduced the number of audiograms by 8.8% and the number of miners by 8.3%.

After deleting those audiograms judged to be invalid, NIOSH's analysis indicates that 90% of these miners have a hearing impairment by age 50 as compared with only 10% of the general population. Even at age 69, only 50% of the non-noise exposed population acquire a hearing impairment. Franks defined material impairment as an average 25 dB hearing level at 1000, 2000, 3000, and 4000 Hz. This definition differs from the MSHA definition of hearing impairment by the inclusion of 4000 Hz in the average.

By age 35 the average miner has a mild hearing loss and 20% have a moderate loss. By contrast, fewer than 20% of the miners having marginally normal hearing by age 64 while the upper 80% have moderate to profound hearing loss. The lower 80% of the non-noise exposed population will not acquire a hearing loss as severe as the one obtained by the average miner regardless of how long they live.

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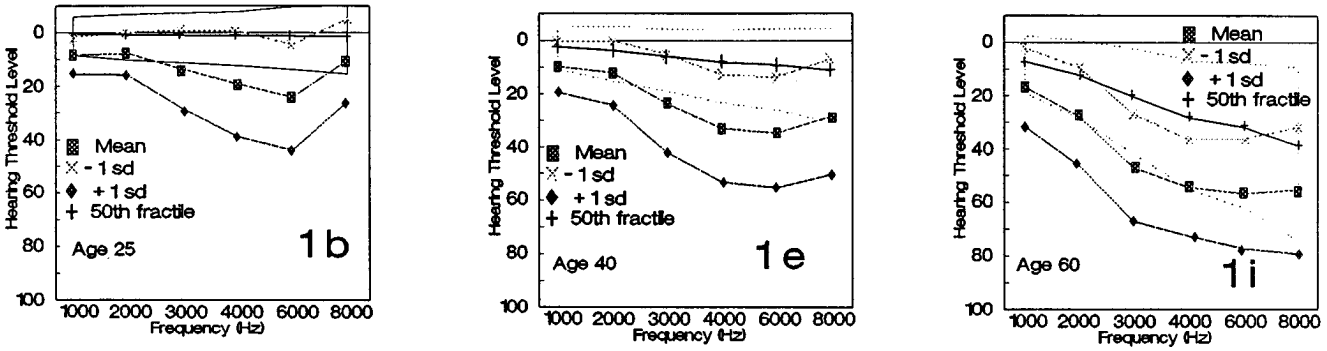

Franks, 1996. Audiograms showing mean hearing threshold level, + 1 standard deviation, - 1 standard deviation, of miners age 25 (1b), 40 (1e), and 60 (1i); other ages in original. Also shown are the 50th fractiles for Annex A of ISO-1999.

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Further, Franks stated that miners, after working 20 to 30 years, could find themselves in life threatening situations since safety signal and roof talk could go unheard.

MSHA separately conducted an elementary analysis of the data, using the definition of material impairment of hearing used throughout the analyses in this preamble: an average 25 dB hearing level at 1000, 2000 and 3000 Hz. For MSHA's analysis, all audiograms were considered to be valid (e.g., no contamination from temporary threshold shifts, sinus conditions, etc.). Information on years of mining experience, noise exposure, use of hearing protectors, and job function was not provided.

In order to reflect current trends, the percentage of current coal miners with a material impairment of hearing was compared to historical data (NIOSH's study on coal miners published in 1976). The audiometric data were placed into a compatible format, e.g., age and hearing loss criteria. Only those coal miners (2,861) whose latest audiogram was taken between 1990 and 1994 were included in the analysis. The results are shown in Chart R1 along with NIOSH's 1976 results for both the noise exposed miners and the non-noise exposed controls.

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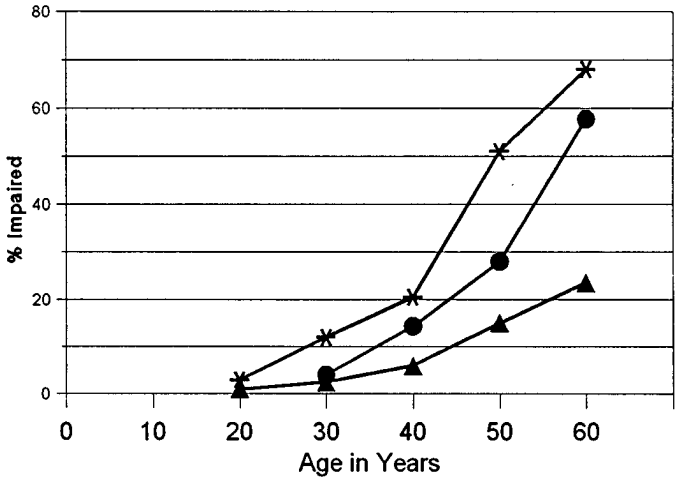
Chart R1. Percentage of Coal Miners Exceeding 25 dB Hearing Loss



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The data points for chart R1 are the mean of both ears at 1000, 2000 and 3000 Hz. The top line connects data points from the 1976 group, and the middle line connects points from the 1990–1994 group; the bottom line represents the non-noise exposed group.

As shown in Chart R1, it is obvious that many coal miners who had audiograms taken from 1990 through 1994 have a material impairment of hearing. These miners were still losing more of their hearing acuity than non-noise exposed workers. This remains true even if the analysis is limited to miners less than 40 years of age (i.e., those who have worked only under the current coal noise regulations). The fact that the loss is at a slower rate than shown in the 1976 data may indicate some progress under the existing regulations compared with no regulation.

Furthermore, MSHA analyzed the data for the number of standard threshold shifts (STS's) and reportable hearing loss cases in order to estimate the number of such events that may occur if the proposal is adopted. In the proposal, MSHA defines an ''STS'' as a change in hearing threshold level relative to the miner's original or supplemental baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear. The importance of an STS is that it reveals that a permanent loss in hearing acuity has occurred relative to that miner's baseline. This is the type of loss that is deserving of mine operator intervention. When the change from the baseline averages 25 dB or more at the same frequencies, the hearing loss must be reported to MSHA so that the Agency can intervene if necessary. (MSHA discusses the definition of STS and reportable hearing loss in detail in the sections of this preamble dealing with proposed §§ 62.160 and 62.190.) In both cases, the data differ from that in Chart R1, which is looking at the hearing loss relative to audiometric zero—not the individual miner's baseline.

For a second analysis, the first audiogram was assumed to be the baseline. The last audiogram was compared to the baseline. Neither audiogram was corrected for presbycusis. Also, because of the lack of supporting data, no provision for excluding an STS as being non-occupational was possible. A total of 3,102 coal miners had a baseline and at least a second audiogram. However, only those miners whose latest audiogram was conducted between 1990 and 1994 were considered. The results are presented in Chart R2.

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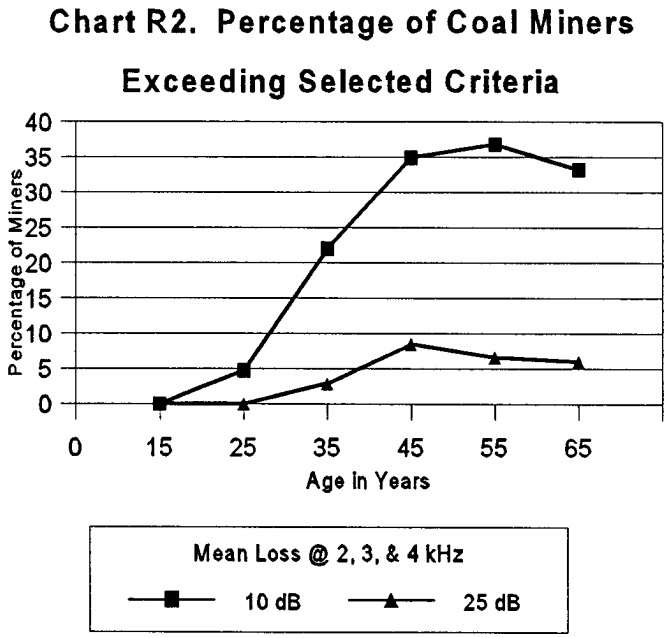

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Chart R2 clearly shows that many of the coal miners from 1990 through 1994 were found to have an STS. The likelihood of acquiring an STS generally increases with advancing age. The MSHA analysis was conducted in a conservative fashion. Because the intervening audiograms were excluded from this analysis, the number of STSs is probably low since only a single STS was recorded. There could be several explanations for the drop in the percentage of STS's for the 65 year old age group in chart R2, including, for example, changed work assignments.

In addition to this privately maintained audiological data, there have been two special NIOSH studies of the hearing acuity of coal miners. These studies were reviewed in detail in the Risk of Impairment section, above. The first study was published in 1976. Even though the majority of noise exposures were found to be less than 90 dBA, approximately 70% of the 60-year-old coal miners had a material impairment of hearing using the OSHA/NIOSH definition. Another NIOSH study, conducted by Hopkinson (1981), corroborated the results of the earlier NIOSH study on the hearing acuity of coal miners.

Commenter Data

In its ANPRM, MSHA solicited comments on the number of current miners with a hearing loss based on suggested criteria. Two commenters provided information on the hearing acuity of miners. The first commenter estimated that 45 to 50% of the employed miners have an STS and at least 25% have an STS if corrected for presbycusis. Further, this commenter estimated that about 25% of the miners have an average hearing loss of 25 dB or more at 1000, 2000, and 3000 Hz. However, when corrected for presbycusis, the percentage of miners with this level of hearing loss decreased to about 15%.

The second commenter referenced a paper presented by Smith et al. at the 1989 Alabama Governor's Safety and Health Conference. This commenter stated that Smith et al. reported on the evaluation of serial audiograms from 100 workers exposed to sound levels less than 85 dBA. Smith et al. had found that 15% of these workers would have some degree of hearing impairment using AAO–HNS 1979 impairment criteria. Smith et al. also reported that at least 26% of the mining population would have some degree of hearing impairment using the same criteria. Smith (1994) confirmed the prevalence of material impairment among miners in a letter to MSHA.

MSHA also requested information on hearing loss to individual miners in its ANPRM. Specific information was requested on each miner who had incurred a hearing loss, including the related noise exposure, state workers' compensation award, cost of the award, miner's age, occupation and degree of hearing loss. The Agency received few comments pertaining to the information requested. The Agency requests additional comment on these issues.

Reported Hearing Loss Data

Another potential body of information about hearing loss among miners comes from reports mine operators are required to submit to MSHA of such losses. At present, however, there is not a definition of ''reportable hearing loss'' linking what is reported to some particular measurement. Rather, under 30 CFR part 50, mine operators are only required to report cases of NIHL to MSHA when it is diagnosed by a physician or when the miner receives an award of compensation.

Nevertheless, between 1985 and 1995 mine operators reported a total of 2,402 cases of NIHL—and among these cases were a substantial number of miners who began working at a mine after the implementation of the current noise regulations.

Coal mine operators reported 608 cases among surface miners, 1,077 cases among underground miners, and 14 cases among miners whose work positions were not identified. According to coal mine operators, 662 of the 1,699 cases began working at a mine after the implementation of noise regulations for coal mines (1972 for underground and 1973 for surface). Workers with no reported mining experience were excluded from this analysis, because their noise exposure history in mining was unknown.

For the same period, metal and nonmetal mine operators reported 555 cases among surface miners and 148 cases among underground miners. According to mine operators, 142 of the 703 cases began working at a mine after the implementation of noise regulations for metal and nonmetal mines (1975). As with the coal data, workers with no reported mining experience were excluded.

Comparing the two types of mining, there were significantly more reported hearing loss cases at coal mines than at metal and nonmetal mines, and a higher proportion of those cases were to workers who began working after the implementation of the current standards. This is despite the fact that, at the present time, there are more metal and nonmetal miners than coal miners employed in the U.S. A possible explanation of the differences between reported cases of NIHL among coal, metal and nonmetal miners may be the more frequent use of engineering noise controls in metal and nonmetal mining.

MSHA reviewed the narrative associated with each NIHL case to determine the degree of hearing loss. Although many narratives contained information as to the reason for reporting the NIHL case, others only listed the illness as ''hearing loss.'' Approximately half the cases had no information on the severity of the hearing loss. Some narratives contained information on the severity of the hearing loss, such as an STS, OSHA reportable case, or percent disability. Based upon the information in the narratives it is not possible to determine an average severity for the NIHL cases.

However, at least 40% of the cases in coal mining were reported to MSHA as the result of the miner being compensated for NIHL. Another 7% of the cases filed a workers' compensation claim for NIHL. In metal and nonmetal, at least 19% of the cases were the result of the miner being compensated for NIHL. Nearly another 3% of the cases filed a workers' compensation claim for NIHL.

MSHA contends that the number of cases reported to the Agency are low because of the following factors: the lack of a specific definition of a NIHL in MSHA's part 50 regulations which may result in confusion on the part of mine operators about which cases to report; the lack of consistency among the states' requirements for awarding compensation for an NIHL and among physicians in diagnosing what constitutes a hearing loss caused by noise; and the lack of periodic audiometric testing in the mining industry.

In summary, current hearing loss reported to MSHA under part 50 cannot be used to accurately characterize the incidence, prevalence or the severity of hearing loss in the mining industry. However, the part 50 data clearly show that miners are incurring NIHL.

Workers' Compensation Data

Another source of information about hearing loss among miners is state workers' compensation agencies and insurance carriers. Many states do not keep detailed workers' compensation data themselves; categorization of data are inconsistent across the states; and there are privacy concerns in obtaining the detailed information needed for studies. MSHA would welcome information about studies of hearing loss that have been performed by the insurance industry or others based on this data.

Valoski (1994) studied the number of miners receiving workers' compensation and the associated indemnity costs of those awards. Despite contacting each state workers' compensation Agency and using two national data bases, he was unable to obtain data for all states. In fact, data were not available from a number of key mining states.

From the data that were available for study, Valoski reported that between 1981 and 1985 at least 2,102 coal miners and 312 metal and nonmetal miners were awarded compensation for occupational hearing loss. The identified total indemnity costs of those awards exceeded 12.5 million dollars excluding rehabilitation or medical costs.

In Niemeier's letter to MSHA, Chan et al. of NIOSH (1995) investigated the incidence of NIHL among miners using information from the Bureau of Labor Statistics' (BLS) Supplementary Data System. Like Valoski, he found the national data to be incomplete. Only 15 states participated in the BLS program between 1984 and 1988. In these 15 states, a total of 217 miners (93 coal miners and 124 metal and nonmetal miners) were awarded workers' compensation for NIHL. Chan et al. stated that because of differing state workers' compensation requirements, it is not possible to directly compare NIHL among the states. These factors limit the usefulness of the obtained data.

MSHA also reviewed reports on workers' compensation in Canada and Australia. The noise regulations and mining equipment used in these countries are similar to those in the U.S. A recent report on workers' compensation awards to miners in Ontario, Canada (1991) revealed that between 1985 and 1989, NIHL was the second leading compensable occupational disease. Approximately 250 claims for NIHL involving miners were awarded annually during that time.

Lescouflair et al. (1980) studied 278 metal and asbestos miners in Quebec, Canada, who claimed compensation for hearing loss. Of the 278 cases, 28.7% (80) were excluded as cases of non-mining NIHL. Approximately 50% (99) of those remaining cases diagnosed as having NIHL were shown to have a hearing impairment based upon the AAOO 1959 criteria and an estimated 63% (125) showed an impairment based upon AAO–HNS 1979 criteria. The miners were exposed to noise for 15 to 49 years and showed a similar occurrence of hearing loss in both surface and underground occupations. The researchers also reported that there was no significant difference in NIHL among the miners for those subjects exposed to a mixture of intermittent-continuous noise versus intermittent noise except at 2000 Hz.

Eden (1993) reported on the Australian mining industry's experience with hearing conservation. Eden quoted statistics from the Joint Coal Board which revealed that NIHL comprised 59% to 80% of the reported occupational diseases from 1982 to 1992. Eden also reported that in New South Wales 474 of 16,789 coal miners were awarded compensation for NIHL. The incidence rate for the total mining industry in New South Wales was about 23 cases per 1,000 workers during 1990–1991. This was the highest rate for any industry in New South Wales.

In conclusion, like reported cases of NIHL, the compensation data are too incomplete to be used for quantitative estimates of the prevalence of NIHL in the mining industry. But like the reported case data, the compensation data that are available do show that numerous cases are still being filed each year at considerable cost. Further, according to the data reported by mine operators, many miners who developed NIHL only worked in mining after the implementation of the current noise regulations. While limited, this evidence of continued risk supplements and supports the data previously presented from scientific studies.

The Agency would welcome the submission of additional data to supplement that which it has been able to gather to date.

Exposures in the U.S. Mining Industry

In this section MSHA presents information on noise exposure in the U.S. mining industry, so as to develop a picture of the mining population at a significant risk of incurring material impairment as a result of that exposure. The exposure levels are particularly high in the coal industry, where hearing protectors, rather than engineering or administrative controls, remain the primary means of miner protection against NIHL. But the data indicate that exposure levels remain high in all sectors of the mining industry even

though noise regulations have been implemented for some time.

Inspection Data

The first presentation, Tables II–9 and II–10, reviews noise exposure data collected by MSHA inspectors from thousands of samples gathered over many years to check compliance with the current permitted levels. Because the proposed rule would alter the way a miner's noise dose is calculated in one respect, MSHA conducted a special survey to obtain data that would reflect this change. The data are presented in Tables II–11 and II–12. The survey data are also presented by occupation in Tables II–13 and II–14. All the readings are in time-weighted 8-hour averages.

Tables II–9 and II–10 display samples which present readings exceeding the permissible exposure limit, a TWA_8 of 90 dBA.

Table II–9 shows noise dose trends in metal and nonmetal mines based on over 232,500 full-shift samples collected by MSHA from 1974 through 1995 using personal noise dosimeters.

TABLE II–9.—METAL AND NONMETAL NOISE DOSE TRENDS 1974 TO 1995 [a]

Year	Number of samples	Number of samples > 90 dBA	Percent of samples > 90 dBA
1974	363	139	38.3
1975	3,826	1,661	43.4
1976	9,164	3,725	40.6
1977	13,485	5,047	37.4
1978	17,326	6,415	37.0
1979	21,176	7,638	36.1
1980	15,185	5,203	34.3
1981	11,278	3,651	32.4
1982	3,208	876	27.3
1983	7,628	2,188	28.7
1984	8,525	2,311	27.1
1985	8,040	2,094	26.0
1986	9,213	2,402	26.1
1987	10,145	2,818	27.8
1988	10,514	2,417	23.0
1989	10,279	2,208	21.5
1990	13,067	2,721	20.8
1991	14,936	2,947	19.7
1992	14,622	2,809	19.2
1993	14,566	2,529	17.4
1994	15,979	2,627	16.4
1995	13,865	1,989	14.4

[a] Data from USBOM' MIDAS data base.

Table II–10 below presents noise dose trends in coal mines based on 75,691 full-shift samples collected by MSHA from 1986 through 1995 using personal noise dosimeters. MSHA actually began routine sampling in coal mines in 1978; however, its data base did not begin until 1986.

TABLE II–10.—COAL MINE NOISE DOSE TRENDS, FISCAL YEARS 1986 TO 1995

Fiscal year	Number of samples	Number of samples >90 dBA	Percent of samples >90 dBA
1986	2,037	593	29.1
1987	12,774	3,314	25.9
1988	11,888	2,702	22.7
1989	11,035	2,313	21.0
1990	10,861	2,388	22.0
1991	6,898	1,635	23.7
1992	6,636	1,660	25.0
1993	7,223	1,908	26.4
1994	6,339	1,656	26.1
1995	5,407	1,219	22.5

The inspection data for the two sectors have also been graphed in charts II–9 and II–10 for years in which MSHA collected data for both sectors.

As illustrated by the charts, the metal and nonmetal sector shows a gradual, but consistent, downward trend in the percent of samples exceeding the current PEL. However, there was no such clear trend for coal mines during the same time period. (It should be noted that while the data points on these 3–D graphs come from the last column of the tables, the shading may make them seem somewhat lower than they are in fact.)

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Chart II-9. U.S. M/NM Industry Noise Dose Trend

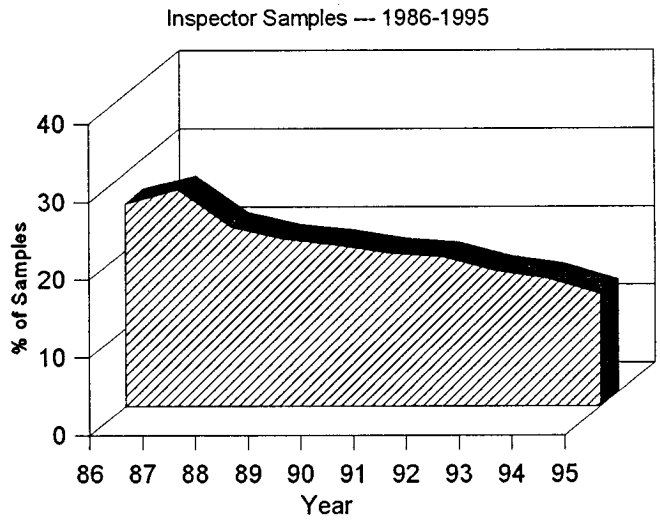
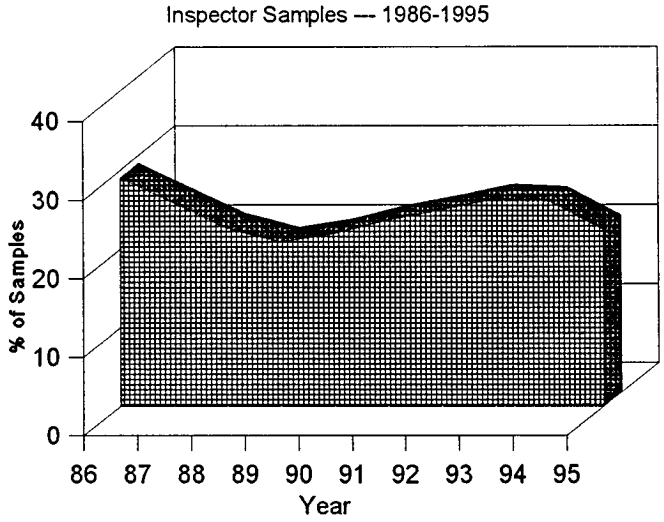


Chart II-10. U.S. Coal Industry Noise Dose Trend



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There are several factors which must be considered when drawing any conclusions from the data. MSHA sampling may be biased towards noisier mines and occupations. Additionally, when an overexposure is found during an initial survey, the data base includes both the initial overexposure and the results of any resampling to determine compliance after the mine operator has utilized engineering and/or administrative controls. While these biases may tend to offset each other, their specific impact cannot be quantified. These factors should, however, impact both sectors roughly equally.

Dual Survey Data

MSHA has concluded that the information contained in Tables II–9 and II–10 understates the actual noise exposures in the industry because the information was collected using a 90 dBA threshold level, i.e. sound levels of less than 90 dBA are not integrated into the results. As discussed later in part III of the preamble, in connection with proposed § 62.120(a), MSHA is proposing to change the threshold level to integrate sound levels of between 80 dBA and 130 dBA because MSHA has concluded that this is warranted by the weight of scientific evidence. Integrating the sound levels between 80 dBA and 90 dBA into the noise exposure will generally increase the measured noise dose. The greater the amount of noise between 80 dBA and 90 dBA the greater the impact on the measured noise dose.

Accordingly, MSHA conducted a special survey to compare noise exposures at different threshold levels. The survey, referred to hereinafter as the ''dual-threshold'' survey, involved the collection of personal noise dosimeter data by MSHA inspectors in coal mines and metal and nonmetal mines. Each sample was collected using a personal noise dosimeter with the capability of simultaneously collecting data at both a 90 dBA threshold and an 80 dBA threshold. All other dosimeter settings were the same as those used during normal compliance inspections (the 90 dB criterion level, 5-dB exchange rate, and A-weighting system which are not now being proposed by MSHA for change). The noise doses were mathematically converted to the appropriate TWA_8 using different criterion levels and threshold values.

Tables II–11 and II–12 display the dual-threshold data: respectively in metal and nonmetal mines, and in coal mines. Table II–11 specifically shows the dual-threshold data collected for metal and nonmetal mines from March 1991 through December 1994 using personal noise dosimeters. This data consisted of more than 42,000 full-shift samples.

TABLE II–11.—M/NM DUAL THRESHOLD SAMPLES AT OR EXCEEDING SPECIFIED TWA_8 SOUND LEVELS FROM MARCH 1991 THROUGH DECEMBER 1994

TWA_8 Sound Level (in dBA)	90 dBA thresholds		80 dBA threshold	
	Number of samples	Percent of samples	Number of samples	Percent of samples
90	7,360	17.4	11,150	26.5
85	.....	.....	28,250	66.9

Note: Two of the boxes in the table do not contain entries. This is to avoid the potential for making an inappropriate comparison of values. Direct comparison of TWA_8 values determined with different thresholds is not appropriate if the TWA_8 is less than one of the thresholds. An example may help to illustrate the point. A miner exposed to a constant sound field of 85 dBA for 8 hours would be determined to have a noise dose of 0%, or a TWA_8 of 0 dBA, if a 90 dBA threshold is used: none of the sound would be counted in the computation. If the exposure was measured using an 80 dBA threshold, the dose would be 50%, or a TWA_8 of 85 dBA. Contrasting the measures taken with the two thresholds would be inappropriate in such a case.

As indicated in Table II–11, 17.4% of all samples collected by MSHA in metal and nonmetal mines during the specified time period equaled or exceeded a TWA_8 of 90 dBA using a 90 dBA threshold—slightly less than the results of inspector sampling in Table II–9. In these instances, engineering and/or administrative controls were required to be implemented in the metal or nonmetal mines to reduce sound levels to the PEL: a requirement that would be retained under the proposed rule. When sound levels between 80 dBA and 90 dBA are taken into account, however, 26.4% of the readings indicated non-compliance. Thus, changing the threshold to properly reflect harmful sound levels indicates harmful noise exposures in this industry are more significant than revealed by the inspection data in Table II–9. Furthermore, 67% of the samples in metal and nonmetal mines exceeded a TWA_8 of 85 dBA using an 80 dBA threshold.

MSHA dual-threshold sampling data for coal mines is presented in Table II–12. This data consists of over 4,200 full-shift samples collected from March 1991 through December 1995 using personal noise dosimeters.

TABLE II–12.—MSHA COAL DUAL THRESHOLD SAMPLES AT OR EXCEEDING SPECIFIED TWA_8 SOUND LEVELS FROM MARCH 1991 THROUGH DECEMBER 1995

TWA_8 Sound Level (in dBA)	90 dBA threshold		80 dBA threshold	
	Number of samples	Percent of samples	Number of samples	Percent of samples
90	1,075	25.3	1,510	35.6
85	.....	.....	3,268	76.9

As indicated in Table II–12, 25.3% of all samples collected by MSHA in coal mines during the specified time period equaled or exceeded a TWA_8 of 90 dBA using a 90 dBA threshold. This percentage increases to 35.6% when an 80 dBA threshold is used. Furthermore, using an 80 dBA threshold, almost 77% of the survey samples from the coal

industry showed noise exposures equaling or exceeding 85 dBA.

Tables II–13 and II–14 present some of the MSHA dual-threshold sampling data by occupation for the most frequently sampled occupations in metal and nonmetal mines and coal mines, respectively. A note of caution: the only data presented in these tables is 90 threshold data at a TWA_8 of 90, and 80 threshold data at a TWA_8 of 85. Accordingly, the columns should not be compared. Perhaps the best way to think of this presentation is as two independent analyses at how the exposure levels of various job categories compare with each other.

TABLE II–13.—PERCENTAGE OF MSHA M/NM SAMPLES[a] BY SELECTED OCCUPATION, EXCEEDING SPECIFIED TWA_8 Sound Levels

Occupation	Number of samples	90 dBA threshold	80 dBA Threshold
		Percent of samples > 90 dBA	Percent of samples > 85 dba
Front-end-loader operator	12,812	12.9	67.7
Truck driver	6,216	13.1	73.7
Crusher operator	5,357	19.9	65.1
Bulldozer operator	1,440	50.7	86.2
Bagger	1,308	10.2	65.0
Sizing/washing plant operator	1,246	13.2	59.7
Dredge/barge attendant	1,124	27.2	78.7
Clean-up person	927	19.3	71.3
Dry screen operator	871	11.7	57.6
Utility worker	846	12.4	60.6
Mechanic	761	3.8	43.9
Supervisors/administrators	730	9.0	32.2
Laborer	642	17.1	65.7
Dragline operator	583	34.0	82.5
Backhoe operator	546	8.4	52.6
Dryer/kiln operator	517	10.5	55.5
Rotary drill operator (electric/hydraulic)	543	39.6	83.1
Rotary drill operator (pneumatic)	489	64.4	89.0

[a] These occupations comprise about 87 percent of the 42,206 MSHA dual-threshold samples collected in metal and nonmetal mines from March 1991 through December 1994. All samples were collected using a personal noise dosimeter over a miner's full-shift.

TABLE II–14.—PERCENTAGE OF MSHA COAL SAMPLES BY OCCUPATION, EXCEEDING SPECIFIED TWA_8 SOUND LEVELS[a]

Occupation	Number of samples	90 dBA threshold	80 dBA threshold
		Percent of samples > 90 dBA	Percent of samples > 85 dBA
Continuous miner helper	68	33.8	88.2
Continuous miner operator	262	49.6	96.2
Roof bolter operator (single)	234	21.8	85.5
Roof bolter operator (twin)	92	31.5	98.9
shuttle car operator	260	13.5	78.5
Scoop car operator	94	18.1	74.5
Cutting machine operator	22	36.4	63.6
Headgate operator	20	40.0	100.0
Longwall operator	34	70.6	100.0
Jack setter (longwall)	25	32.0	68.0
Cleaning plant operator	107	36.4	77.6
Bulldozer operator	225	48.9	94.2
Front-end-loader operator	244	16.0	76.6
Highwall drill operator	83	21.7	77.1
Refuse/backfill truck driver	162	13.6	78.4
Coal truck driver	28	17.9	64.3

[a] Above sampled occupations comprise about 71.0% of the 4,247 MSHA dual threshold samples collected in coal mines from March 1991 to December 1995. All samples were collected using a personal noise dosimeter over a miner's fullshift.

As shown in these tables, the percentage of miners exceeding the specified sound levels varied greatly according to occupation. For example, Table II–13 shows that only 8.4% of the backhoe operators in metal and nonmetal mines had noise exposures exceeding a TWA_8 of 90 dBA using a 90 dBA threshold, while 64.4% of the pneumatic rotary drill operators had similar exposures. When reviewing the same two occupations, 52.6% of the backhoe operators and 89.0% of the pneumatic rotary drill operators would have noise exposures exceeding a TWA_8 of 85 dBA using an 80 dBA threshold.

Conclusion; Miners at Significant Risk of Material Impairment

MSHA has prepared an exposure profile of miners based on the data presented in this part; the methodology is summarized in the following paragraphs and described in detail in the Agency's preliminary RIA. Based on this profile, MSHA has concluded that despite many years under existing standards, noise exposures in all sectors of mining continue to pose a significant risk of material impairment to miners over a working lifetime.

Specifically, MSHA estimates that 15% of coal miners will incur a material impairment of hearing under present exposure conditions, or 18,947 coal miners. The figures are 13% of metal and non-metal miners (26,977 metal and nonmetal miners) and 14% of miners as a group (45,924 miners). (The figures include contract miners but exclude certain office workers.)

To derive this information, MSHA began with the 80 dBA exposure data discussed in the prior section. The sampling data were sorted by exposure range: e.g., samples with a TWA_8 of between 80–84.9 dBA, those between 85–89.9 dBA, those between 90–94.9 dBA, and so on.

The sampling data were then adjusted by subtracting 5 dBA from the exposure readings for all samples that had a TWA_8 of 90 dBA at the 90 threshold. These are the samples that would be above the current PEL. MSHA assumed that mine operators currently issue personal HPDs to miners exposed at or above the PEL, that miners are using the HPDs, and that such protection reduces the miner's equivalent TWA_8 noise exposure by about 5 dBA. (There is an extended discussion in part III of this preamble about hearing protector effectiveness, and appropriate references, that shed further light on these assumptions.)

Then the percentage of adjusted samples within each range was multiplied by MSHA's estimates of the total number of mine employees. Those estimates are based on information gathered by the former USBOM (and are presented in part IV of this preamble as part of the Agency's industry profile).

Finally, to establish the number of miners expected to incur a material impairment of hearing, the Agency multiplied the number of miners in each exposure range by the risk of impairment of exposure at that range for a lifetime. For this purpose, the Agency used the 1972 NIOSH risk estimates discussed earlier in this part. (The Agency is aware that NIOSH is currently working on revising its estimates using a different model and taking hearing loss at an additional frequency into account; but until such an approach is peer reviewed, MSHA has concluded it should rely upon the 1972 estimates.)

Based on these assumptions, Table II–15 presents MSHA's profile of the projected number of miners currently at significant risk of developing a material impairment of NIHL under existing exposure conditions.

TABLE II–15.—PROJECTED NUMBER OF MINERS LIKELY TO INCUR NIHL IMPAIRMENT UNDER EXISTING STANDARDS AND EXPOSURE CONDITIONS

	<80	80–84.9	85–89.9	90–94.9	95–99.9	100–104.99	≧105	Total*
Coal	0	599	11,956	5,622	643	111	16	18,947
M/NM	0	1,225	16,910	7,580	1,190	62	10	26,977
Total*	0	1,825	28,866	13,201	1,833	173	26	45,924

*Includes contractor employees. Does not include office workers. Discrepancies are due to rounding.

When MSHA promulgated noise standards in 1971 for underground coal mines, in 1972 for surface coal mines, and in 1974 for metal and nonmetal mines, compliance with the requirements was thought to be adequate to prevent the occurrence of NIHL in the mining industry. Since that time, however, there have been numerous awards of compensation for hearing loss among miners.

Moreover, MSHA's requirements are dated in light of the Agency's experience, that of other domestic and foreign regulatory agencies, and the recommendations of experts on what it takes to have an effective prevention program. NIOSH, for example, currently recommends a comprehensive program which includes the institution of an HCP to prevent NIHL; MSHA's current standards do not include such protection.

In light of current scientific evidence demonstrating that NIHL constitutes a serious hazard, the evidence of continuing harm to miners, and the fact that MSHA standards no longer reflect experience and expert advice, MSHA has concluded that there is a need to replace its existing noise standards with new standards that would provide additional protection to miners. Section 101(a)(6)(A) of the Federal Mine Safety and Health Act of 1977 (Mine Act), states that MSHA's promulgation of health standards must:

> * * * [A]dequately assure on the basis of the best available evidence that no miner will suffer material impairment of health or functional capacity even if such miner has regular exposure to the hazards dealt with by such standard for the period of his working life.

Significant NIHL clearly is the type of material impairment of health, which Congress has directed the Secretary of Labor (Secretary) to prevent. MSHA has concluded that the new requirements in this proposal are necessary to prevent large numbers of miners from suffering material impairment of health resulting from exposure to noise. Compliance will reduce NIHL among miners and the costs associated therewith.

Based on these studies and MSHA's own calculations and analysis presented above, the Agency has concluded that regulatory action is necessary to address the continued excess risk of NIHL resulting from mining employment.

III. Discussion of Proposed Rule

Summary

This part of the Supplementary Information reviews the provisions of the proposed rule, along with the information, comments and alternatives considered by MSHA in developing each feature of the proposal.

While the Agency is seeking to present a complete picture of the basis for its preliminary decisions, so as to facilitate comment, space considerations preclude a full presentation of all of the sources reviewed by the Agency. Part V is a complete reference list of those sources. Among other things, part V contains a list of publications by the former USBOM that were reviewed by the Agency. Many of these describe methods for controlling noise for particular types of mining equipment or facilities, and thus supplement the discussion in this part about feasible engineering controls. All constitute part of the Agency's rulemaking record.

In addition to the materials cited in part V, the Agency researched the noise regulatory codes of a number of other jurisdictions—including those of the military and of other countries. While these codes are noted in this part in a few summary tables, and discussed in connection with certain key requirements being proposed by the Agency, the Agency has determined there is no need to elucidate their requirements in each and every section of this part. Nevertheless, these codes also constitute part of the Agency's rulemaking record.

Section 62.100 Purpose and Scope; Effective Date

Purpose

The purpose of the standards in proposed part 62 is the prevention of occupational noise-induced hearing loss among miners. It is important to clearly state the purpose of the regulations: to clarify it to the regulated public and Agency personnel, and so that the effectiveness of the regulations over time can be measured consistent with principles under the Government Performance Results Act.

Scope

Part 62 would set forth health standards for all coal, metal and nonmetal mines, both surface and underground, subject to the Federal Mine Safety and Health Act of 1977. MSHA currently has four sets of noise standards: for surface metal and nonmetal mines (30 CFR 56.5050), for underground metal and nonmetal mines (30 CFR 57.5050), for underground coal mines (30 CFR part 70, subpart F), and for surface coal mines and surface work areas of underground coal mines (30 CFR part 71, subpart I). In fact, however, there are really two groups of standards: those applicable to coal mines and those applicable to metal and nonmetal mines. This is because the surface and underground standards for noise in metal and nonmetal mines are identical; the same is true of the surface and underground standards for noise in coal mines. The differences between the standards applicable in the coal industry and in other mining industries are discussed in detail in the following pages.

Part 62 would establish a single, uniform noise standard applicable to all mines. This approach is favored by many. Those who responded to MSHA's ANPRM generally agreed that consolidation and simplification of multiple standards into one may help to facilitate understanding of, and thus compliance with, regulatory requirements. Such an approach is also traditional with noise: OSHA's standards apply uniformly to hundreds of industries.

The proposed standard is not identical to the existing coal standard nor to the existing metal and nonmetal standard. Nor is the proposal identical to the noise standard which has been applicable to most other industries since 1983 pursuant to the Occupational Safety and Health Act (29 CFR 1910.95). Conditions in the mining industry, experience with the current standards, MSHA's review of the latest scientific information, the comments submitted in response to the ANPRM, and the requirements of the Mine Safety and Health Act have led the Agency to propose a standard that is unique in some respects. Nevertheless, many key features in the proposal are identical to features in one or more of the existing noise standards.

Several charts comparing the features of the proposed standard to the features of existing MSHA and OSHA noise standards are included in the ''Question and Answers'' in part I of the Supplementary Information accompanying this notice.

Effective Date

MSHA recognizes that successful implementation of these new and uniform health rules will require new training of MSHA personnel and guidance to employees and mine operators, particularly small mine operators. Accordingly the Agency is proposing that the new standards take effect one year after the date of publication of the final rule. An alternative would be to phase in the new requirements. The Agency believes some could be phased in quickly, but wants to avoid confusion. The Agency requests comment on whether a phased-in approach is appropriate and how it might most effectively be designed.

Section 62.110 Definitions

The proposal would include some definitions to facilitate understanding.

The definitions include some technical terms universally used in noise measurement, e.g., criterion level.

The definitions also include some terms used in the mining industry in a way that differs from usage in other contexts, e.g., usage under the OSHA standard. One example is the term ''hearing conservation program'' or ''HCP.'' Under the proposal, requirements for hearing protectors and training are not always linked to audiometric testing results as they are under the OSHA standard. To avoid confusion, the proposal defines a hearing conservation program as a generic reference to those sections of the proposal that set forth the requirements for an audiometric testing program. Another example is the definition of ''qualified technician''.

The definitions also include some terms which are non-standard. In particular, the Agency is proposing to use the term ''supplemental baseline audiogram'' instead of the more commonly used ''revised audiogram''; MSHA believes its terminology will make it easier for the mining industry to understand the requirements of the proposal.

The discussion which immediately follows summarizes the salient features of the definitions. A more detailed discussion of the definitions is contained in those sections of the preamble which review the context in which each definition is to be used.

Access

Access is the right to examine and copy records. This is consistent with the use of this term in several of MSHA's and OSHA's existing health standards.

Audiologist

A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners. MSHA has included this definition primarily to indicate which organizations certify or license audiologists. MSHA has decided that all practicing audiologists should be either licensed or certified by one or both of the above organizations. This term is considered in the section of this preamble that discusses proposed § 62.140 *Audiometric testing program*.

Baseline Audiogram

The audiogram against which future audiograms are usually compared. By comparing an annual audiogram to the baseline audiogram the progression of noise-induced hearing loss can be determined. This term is considered in the section of this preamble that discusses proposed § 62.140, *Audiometric testing program*.

Criterion Level

This refers to the sound level which if applied for 8 hours results in a dose of 100% of that permitted by the standard. Under proposed § 62.120(a), the criterion level would be a sound level of 90 dBA. If applied for 8 hours, this sound level would result in a dose of 100% of the permissible exposure limit (PEL), established by proposed § 62.120(c) as an 8-hour-time-weighted average of 90 dBA. The PEL and the

criterion level are not the same thing. While the PEL is a sound level of 90 dBA for 8 hours, it is also a sound level of 95 dBA for 4 hours; the criterion level is always a constant, derived from what the PEL is at 8 hours of exposure.

Decibel (dB)

Unit of measurement of sound. Decibel is used to describe environmental/occupational sounds and hearing acuity.

Decibel, A-weighted (dBA)

Sound levels measured using the A-weighting network. There are several frequency response networks which have been developed, as noted in the section of the preamble discussing proposed § 62.120(a). A-weighting refers to the frequency response network closely corresponding to the frequency response of the human ear. This network attenuates sound energy in the upper and lower frequencies (<1000 and >5000 Hz) and slightly amplifies those frequencies between 1000 and 5000 Hz. The characteristics of the A-weighting network are found in ANSI S1.25–1991, ''Specification for Personal Noise Dosimeters''.

Designated Representative

A designated representative is an individual or organization to whom a miner gives written authorization to exercise a right of access to records, pursuant to proposed § 62.200.

Exchange Rate

The amount of increase or decrease in sound level which would require halving or doubling the allowable exposure time to maintain the same noise dose. In this proposal, a 5-dBA increase in the sound level would correspond to a halving of the allowable exposure time. Exchange rate is discussed in detail in the section of this preamble discussing proposed § 62.120 *Noise exposure levels.*

Hearing Conservation Program (HCP)

An HCP is designed to detect early changes in a miner's hearing acuity so that corrective action can be instituted to minimize future hearing loss. In general parlance, an HCP is a system of audiological examinations that provide guidance for the use of hearing protectors, other controls, and training. In the proposed rule, however, hearing protector use and training linked to audiological examinations are only a limited subset of the hearing protector and training requirements. Accordingly, to avoid confusion, the term ''hearing conservation program'' in the proposed rule is defined as a generic reference to the requirements of §§ 62.140 through 62.190 of part 62, the requirements dealing with audiological examinations and the corrective actions linked thereto.

Hearing Protector

The purpose of this definition is to clarify that not all devices or materials inserted in or that cover the ear to reduce the noise exposure can qualify as a hearing protector. For example, MSHA does not consider a hearing aid as a hearing protector.

A hearing protector must meet two requirements. First, to be a hearing protector a device must be sold wholly or in part on the basis of its ability to reduce the level of sound entering the ear. Thus, cotton would not be an acceptable hearing protector. Second, the device must have a scientifically accepted indicator of noise reduction value.

MSHA's definition encompasses that used in the Environmental Protection Agency's (EPA) labeling standards for hearing protectors (40 CFR § 211.203(m)). The EPA defines a hearing protector as:

> * * * any device or material, capable of being worn on the head or in the ear canal, that is sold wholly or in part on the basis of its ability to reduce the level of sound entering the ear. This includes devices of which hearing protection may not be the primary function, but which are nonetheless sold partially as providing hearing protection to the user.

EPA requires that all hearing protector manufacturers include labeling information with their products that indicate their Noise Reduction Rating (NRR). Thus, if a hearing protector has such a label, the mine operator can be confident that it meets MSHA's definition of a hearing protector. As noted in the discussions of proposed § 62.120(a), MSHA does not believe the NRR ratings are meaningful in workplace situations; moreover, other organizations have recommended that the EPA reconsider the rating system it uses. MSHA is therefore not proposing to delimit the range of hearing protectors that may be offered to only those with an NRR as such; rather, any scientifically accepted indicator of noise reduction value will be acceptable evidence of the product's purpose.

The Agency is interested in comments on this definition.

Hertz (Hz)

A unit of measurement of frequency, numerically equal to cycles per second. The range of audible frequencies is 20 to 20,000 Hz.

Medical Pathology

A condition or disease affecting the ear. The term is used in the proposed rule in contexts which do not require actual diagnosis and treatment; see specifically the discussion of proposed §§ 62.125 and 62.170. Medical conditions of this type should ultimately be diagnosed and treated by a physician specialist, e.g., an otolaryngologist.

Qualified Technician

A technician who has been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC) or by another recognized organization offering similar certification. MSHA has decided that requiring a technician to be certified would ensure that audiometric tests are administered by a competent person. The definition of ''qualified technician'' is discussed in connection with proposed § 62.140 *Audiometric testing program.*

Reportable Hearing Loss

This defines the extent of hearing loss which must be reported to MSHA so the Agency can intervene to prevent further hearing loss. Such reporting is already required pursuant to 30 CFR part 50. This definition clarifies how the requirements of 30 CFR part 50 apply in the case of noise.

The definition in the proposed rule would require that hearing loss be calculated by subtracting the current hearing levels from those on the baseline audiogram at 2000, 3000, and 4000 Hz; when the permanent hearing losses at each frequency are averaged (added up and divided by three), the hearing loss must be reported if the average loss in either ear has increased by 25 dB. In making this calculation, a supplemental baseline audiogram would be used in lieu of the baseline audiogram in those cases in which the supplemental audiogram was created because of a significant improvement in hearing acuity, in accordance with the provisions of proposed § 62.140(d)(2).

The definition of reportable hearing loss is discussed in connection with proposed § 62.190, *Notification of results; reporting requirements.* As discussed therein, the Agency is specifically seeking comment on two points: (a) an appropriate definition of reportable hearing loss in those cases in which operators lack an audiometric test record; and (b) the nature of the hearing loss that MSHA should capture through its part 50 reporting system.

Sound Level (in dBA)

The sound pressure level measured in decibels using the A-weighting network and exponential time averaging. Pursuant to proposed § 62.120(a)(3)(iv), sound pressure levels would be measured using the A-weighting network and the slow-response time constant. Sound consists of pressure changes in air caused by vibrations. These pressure changes produce waves that move out from the vibrating source. The sound level is a measure of the magnitude of these pressure changes and is generally perceived as loudness.

Standard Threshold Shift (STS)

This defines the extent of hearing loss which requires intervention by a mine operator pursuant to proposed § 62.180.

An STS is a measure of permanent change for the worse—relative to a miner's baseline audiogram, or relative to the most recent supplemental audiogram where one has been established pursuant to proposed § 62.140(d). The definition in the proposed rule would require that hearing loss be calculated by subtracting the current hearing levels from those measured by the baseline (or supplemental) audiogram at 2000, 3000, and 4000 Hz; when the hearing losses at each frequency are averaged (added up and divided by three), the hearing loss would be considered an STS if the average loss in either ear has reached 10 dB.

MSHA discusses this definition in detail in connection with proposed § 62.160, *Evaluation of audiogram*.

By contrast with an STS, a temporary threshold shift (TTS) is a temporary change in hearing acuity, which corrects itself after sound levels are decreased and does not permanently impair hearing. The latter term is used frequently in the preamble, but is not needed in the proposed rule.

Supplemental Baseline Audiogram

This is an annual audiogram used in certain specific cases in lieu of the baseline audiogram to measure reportable hearing loss or standard threshold shift. Some professionals prefer the term ''revised'' baseline audiogram; in this proposal, ''supplemental'' is used to ensure mine operators are clear that the integrity of the original ''baseline'' audiogram must be preserved.

A supplemental baseline audiogram is established under the circumstances set forth in proposed § 62.140(d)(1) or 62.140(d)(2). See the discussion of those sections in this preamble, as well as the related discussions of ''reportable hearing loss'' and ''standard threshold shift.''

Time-Weighted Average-8 Hour (TWA_8).

That sound level, which if constant over an 8-hour time period, would result in the same noise dose as is measured. This yardstick measurement is used in the rule in connection with various limitations; for example, the proposed PEL would be a TWA_8 of 90 dBA.

Not all noise measurement instruments give readouts in terms of time-weighted 8-hour averages. Many personal noise dosimeters, for example, measure noise as a percentage of permitted dosage, with the PEL equated to 100%. Mine operators therefore need to convert noise dose to an equivalent TWA_8 to determine if the action level or the PEL has been exceeded, and to evaluate the impact of engineering controls. Accordingly, MSHA has provided a list of TWA_8 conversion values in Table 62–2, included in proposed § 62.120. The table has been compiled by equating a dose of 100% to the proposed PEL. For example, a dose of 50% equals a TWA_8 of 85 dBA—the level at which some protective action must be taken under the proposal.

The TWA_8 and the dose are to be used interchangeably. Since the noise exposure will be measured for the entire shift, compliance with the noise standard will be based upon the measured dose. If the measured dose exceeds 100%, regardless of the length of the workshift, the miner will be considered to be overexposed to noise. It would thus be improper to adjust a TWA_8 reading for an extended work shift.

Care should be taken not to assume that those models of personal noise dosimeters which give readouts in both the noise dose and the ''average sound level'' in dBA are giving a TWA_8 readout. The ''L_{avg}'', or average sound level, is the constant sound level which equals the dose over the measurement period. The value of the TWA_8 is the same as the L_{avg} if the measurement period is 8 hours.

It should be noted that the TWA_8 is a term used in the context of a 5-dB exchange rate. In the context of a 3-dB exchange rate, the equivalent term is the ''$L_{eq,8}$''. The latter term is used occasionally in the preamble—in discussing the possible use of a 3-dB exchange rate, and in those studies performed with data from countries using a 3-dB exchange rate.

Section 62.120 Limitations on Noise Exposure

Introduction

The provisions of this section of the proposed regulation deal with some critical subjects: how to compute a miner's noise dose; the hierarchy of controls at different noise exposure doses; and the monitoring of noise exposure.

Specifically, paragraph (a) of proposed § 62.120 provides the parameters for computing the amount of noise to which a miner is exposed—a miner's noise dose. Paragraphs (b) through (d) establish a series of noise exposure limitations, and the specific mine operator actions required if noise exceeds that level. Paragraph (e) establishes a ceiling on sound levels to which a miner may be exposed. Paragraph (f) establishes a mine operator's obligation to evaluate each miner's noise exposure to determine if it exceeds any of the limitations established by this section, and to notify miners at risk.

A short summary of each subsection follows. Thereafter, a more detailed presentation is provided.

§ 62.120(a)

Proposed paragraph (a) sets forth a formula for dose computation which corresponds to the measurements made by most current personal noise dosimeters. It further specifies that: all sound levels from 80 dBA to at least 130 dBA be integrated into the dose measurement, including impact/impulse noise in that range; noise be measured over a full shift; a 5-dB exchange rate be used; and that measurements be made using the A-weighting network and slow response instrument settings. This paragraph also clarifies that measurement of noise dosage is to be made without regard for the effect of a hearing protector.

The exchange rate is the measure that reflects how much of a decrease in exposure time is required when the sound level increases. The proposed 5-dB exchange rate is the same as under current standards. Using that rate, the exposure permitted at a sound level of 90 dBA is half that permitted at a sound level of 85 dBA—a miner gets the same noise dose in 4 hours at 90 dBA as at 8 hours at 85 dBA.

The Agency currently uses a 5-dB exchange rate. There appears to be a consensus in the recent literature for an exchange rate of 3-dB. Moreover, the current 5-dB exhange rates incorporates an assumption that there is significant time for hearing to recover from high sound levels. MSHA has concluded that

noise exposure under mining conditions does not warrant such an assumption. A 3-dB exchange rate does not incorporate this assumption.

Nevertheless, the Agency is proposing to retain the existing 5-dB exchange rate because of feasibility considerations. Changing to a 3-dB rate from a 5-dB rate would significantly reduce the amount of time that miners could be exposed to higher sound levels without exceeding the permissible exposure limit. For example, MSHA estimates that the percentage of miners whose exposure would be in violation of a PEL set at a $L_{eq,8}$ of 90 dBA would be just about double that of a PEL set at a TWA_8 of 90 dBA. This means mine operators would have to utilize controls to reduce exposures to the PEL more frequently—and the controls required to reduce exposures that much would be more expensive. Furthermore, it is extremely difficult to reduce the noise exposures to below a $L_{eq,8}$ of 90 dBA using currently available engineering or administrative noise controls or a combination thereof. Accordingly, moving the industry to a 3-dB exchange rate may be infeasible at this time. (Part IV contains a further discussion of feasibility issues.)

Two features proposed with respect to noise measurement of particular significance are: lowering the threshold at which sound levels are integrated into a miner's noise dose, and prohibiting the adjustment of noise measurements to provide credit for hearing protector attenuation.

MSHA is proposed that the threshold for integrating noise into dose measurements be expanded to cover sounds as low as 80 dBA. This decision is based on strong evidence that such exposures do contribute to hearing impairment. While more protective than the present threshold of 90 dBA, this change will generally result in higher dose readings in both the coal and metal and nonmetal sectors than at present. For example, MSHA's dual-threshold survey indicated that in the metal and nonmetal industry, the percentage of samples above the PEL increased from 17.4% at a 90 dBA threshold to 26.4% at an 80 dBA threshold; in coal the figures increased from 25.3% to 35.6%.

Moreover, the proposed regulation would not allow dose measurements to be adjusted in those cases in which miners are wearing hearing protectors. This is consistent with the thrust of the proposal to establish for all mining sectors a hierarchy of controls for noise in which primary reliance will be upon engineering and administrative controls.

§ 62.120(b)

Proposed paragraph (b) establishes an ''action level'' at a TWA_8 of 85 dBA.

The need for an action level reflects two facts: (1) There is a significant risk of material impairment to miners from a lifetime of exposure to noise at this level; and (2) the Agency believes it may not be feasible at this time to lower the PEL to this level, since that would require that mine operators use all feasible engineering and administrative controls to reduce noise exposures to this level.

The proposal would require that all miners exposed above the action level be provided special instruction in the hazards of noise and protective methods. The training is to be provided annually for as long as exposure exceeds the action level. (The nature of this instruction, how it is to be provided, and how it can be coordinated with other required miner training are subjects discussed in connection with proposed § 62.130.)

If a miner's exposure exceeds the action level but is below the PEL, an operator will also be required to enroll a miner whose exposure exceeds the action level in a hearing conservation program (HCP). While enrollment in the HCP would require the operator to make annual audiometric testing available to the miner, miners exposed to noise below the PEL would have the right to decline taking any annual audiometric testing. The requirements for such testing are discussed in connection with proposed § 62.140, audiometric test procedures. MSHA is seeking comments on how to minimize the burden on mine operators of providing audiometric examinations for those miners with only a temporary attachment to the mining work force (e.g., summer employees), while recognizing the importance of detecting and tracking hearing loss among those who switch jobs.

In addition, the operator must provide properly fitted hearing protection—before the initial hearing examination, if a significant threshold shift in hearing acuity is detected, and at any other time upon miner request. Should it take more than 6 months to provide the initial hearing examination because of the need to wait for a mobile test van, or should a significant threshold shift in hearing acuity be detected, the operator would also be required to ensure that the miner wear the hearing protection—even if the miner's noise exposure remains under the PEL. (A discussion of the timeframes for audiometric tests, and the use of mobile test vans, is included in the discussion of proposed § 62.140, audiometric test program. The definition of a significant threshold shift is discussed in connection with proposed § 62.160, evaluation of audiogram).

An action level currently exists under OSHA but would be new to the mining industry. As discussed herein, MSHA proposes to build upon the requirements which have been used by OSHA while giving due regard to implementation approaches appropriate to the circumstances of the mining community.

§ 62.120(c)

Proposed paragraph (c) would establish the permissible exposure limit (PEL) to noise for a miner as a TWA_8 of 90 dBA during any workshift. (This is also referred to as a dose measurement of 100%; the action level TWA_8 of 85 dBA is half this dose of noise.) The proposal further provides that if the PEL is exceeded, in addition to the controls required at the action level, the mine operator shall use all feasible engineering and administrative controls to reduce the miner's noise exposure to the PEL. The mine operator has a choice of whether to use engineering controls, administrative controls, or both; but if administrative controls are utilized, a copy of the procedures involved must be posted, and copies given to the affected miners.

If reducing the dose to this level with such controls is not feasible, the proposal requires the mine operator to use such controls to lower the noise exposure as much as is feasible.

In addition, in such cases, the proposal requires that the operator take extra steps to protect miner hearing. The operator must ensure all miners so exposed take the annual hearing examinations, must provide properly fitted hearing protection to all miners so exposed, and must ensure the hearing protection is used by all miners so exposed.

Under the proposal, a consistent hierarchy of controls is established for all mines. Mine operators must first utilize all feasible engineering and administrative controls to reduce sound levels to the PEL before relying on other controls to protect against hearing loss. This approach is consistent with that currently in place for metal and nonmetal mines, but would be a change for coal mines. As discussed herein (in connection with proposed § 62.125, hearing protectors), MSHA has considerable evidence that primary reliance upon hearing protectors, as is the current case in the coal industry, is misplaced.

As under the present standards, the proposal would require a mine operator

to use only such engineering controls as are technologically feasible, and to use only such engineering and administrative controls as are economically feasible for that mine operator.

As noted, the proposed rule provides for supplemental controls in those cases in which the Agency concurs with a mine operator that the use of all feasible engineering and administrative controls cannot reduce noise to the PEL. MSHA believes that when a miner is exposed to such high levels of noise, these supplemental obligations are necessary to protect miner hearing. Hearing protectors are not without their discomforts; but the risk of hearing loss at such exposure levels ought to be the controlling factor. While audiometric testing is not an invasive procedure, the Agency is concerned that there may be economic pressures and personal reasons that may lead miners to decline to take hearing examinations. The information generated by these tests is necessary, however, to trigger investigation of potentially serious flaws in the layers of noise controls required at these high exposure levels. In addition, the Agency believes that miners operating under such high noise conditions should be aware of the severity of any hearing loss; in a mining environment, this knowledge could have implications for the safety of the miner and the safety of others. Comments on this provision are specifically solicited.

§ 62.120(d)

Proposed paragraph (d) provides that should a miner's noise exposure exceed a TWA_8 of 105 dBA during any workshift, a dose of 800% of the PEL, the mine operator shall, in addition to taking all of the actions required when exceeding the PEL, require the miner to use dual hearing protection—i.e. both a plug type and a muff type hearing protector. In this context, the Agency presents information about the mining jobs at which the exposures of this level are occurring; and requests comment on whether there should be an absolute dose ceiling, regardless of the feasibility of control by an individual mine operator.

§ 62.120(e)

Proposed paragraph (e) would provide that at no time shall a miner be exposed to sound levels exceeding 115 dBA.

§ 62.120(f)

Proposed paragraph (f) consists of two parts. First, it would require mine operators to establish a system of monitoring which effectively evaluates each miner's noise exposure. This will ensure that mine operators have the means to determine whether a miner's exposure exceeds any of the limitations established by this section, as well as to assess the effectiveness of noise controls. The proposed rule is performance oriented in that the regularity and methodology used to make this evaluation are not specified. Specific requirements for periodic monitoring now applicable to the coal sector would be revoked.

Proposed paragraph (f) would also require that miners be notified in writing should their exposure exceed any of the levels specified by this section—whether based on operator or MSHA evaluations of noise. Notice would be required within 15 calendar days.

The proposal has been designed to ensure that miners are made aware of the hazards they currently face. Miners exposed above the action level should be notified of that fact so, for example, they can consider the importance of using provided, properly fitted and maintained hearing protectors. On the other hand, the proposal does not require notification of a particular miner if an exposure measurement indicates that the miner's exposure has not changed and the miner has within the last year been apprised of the same information.

The proposal has no provision for requiring the posting of warning signs.

Dose Computation

Proposed § 62.120(a) sets forth important technical specifications on computing noise dose. These specifications were utilized in the establishment of the limitations set forth in this section; they therefore must be utilized in dose measurements taken to determine compliance.

Using a Personal Dosimeter

The dose itself is usually read directly from a personal noise dosimeter. The dosimeter is set to the specifications required by the proposed standard (e.g. 80 dB threshold), attached to the miner, and the total dose read out at the end of the full work shift.

Using a Sound Level Meter

Some operators may prefer to take a series of individual readings with sound level meters, and derive the dose from these readings. Accordingly, the proposal also sets forth the formula for determining the dose in this fashion.

Proposed § 62.120(a)(1) would specify that noise dose is to be computed by combining the sound levels during various periods of time during the miner's measurement period, in accordance with the formula:

$D=100(C_1/T_1 + C_2/T_2 + * * * + C_n/T_n)$,

where:

D=the percent of permissible exposure,
C_n=the total time of exposure at a specified sound level, and
T_n=the reference duration of exposure at that level, as listed in Table 62–1.

Table 62–1 contains reference durations for sound levels from 85 to 115 dBA. The sound levels to be integrated into the dose measurement pursuant to this proposal actually range from 80 to 130 dBA. Reference durations for sound levels not in the table can be calculated pursuant to the formula in the table note. (For a detailed discussion of this topic see the section of this preamble entitled *Threshold and range of integration*.)

As noted, current personal noise dosimeters automatically compute a miner's noise exposure essentially using the above formula. In fact, noise dose is relatively simple to compute when the sound level is constant throughout the work shift. For example, a miner is exposed to 95 dBA for 2 hours and has no additional noise exposure. The reference duration, from Table 62–1, for 95 dBA is 4 hours. Substituting the values into the above formula yields:

D=100 (2/4) or equivalently 50%.

When a miner is exposed to fluctuating sound levels, the total noise dose can be computed using the same formula. For example, a miner is exposed to 90 dBA for 1 hour, 95 dBA for 2 hours and 100 dBA for 1 hour. The reference durations from Table 62–1 are 8 hours, 4 hours, and 2 hours, respectively. Substituting the values into the above formula yields:

D=100 (1/8+2/4+1/2) or 100 (0.125+0.50+0.50) or equivalently 112.5%.

Conversion of Dose to TWA_8

Table 62–2, included in proposed § 62.120(a)(2), has been constructed to permit dosage measurements to be converted readily into time-weighted average 8-hour (TWA_8) measurements.

The TWA_8 is the sound level which if constant over an 8-hour time period, would result in the same noise dose as is measured. This yardstick measurement is the one used to establish the action level, PEL, and double-hearing protection supplemental control level in the proposed regulation. Since personal noise dosimeters measure noise as a percentage of permitted dosage, with the permissible exposure limit (PEL) equated to 100%, this table allows for ready conversion of

those measurements into a form that measures compliance.

As stated previously, the TWA_8 and the dose are to be used interchangeably. It is intended that the TWA_8 not be adjusted for extended work shifts. Since the noise exposure will be measured for the entire shift, compliance with the noise standard will be based upon the measured dose. If the measured dose exceeds 100%, regardless of the length of the workshift, the miner will be considered to be overexposed to noise. MSHA requests commenters to review the proposed rule and offer suggestions to help the Agency ensure that this intention is clearly conveyed in the rulemaking language.

The table has been constructed by equating the proposed PEL to a dose of 100%. More specifically, the TWA_8 conversion values in Table 62–2 are based on the use of a 90 dBA PEL, 80 dBA threshold, and a 5-dB exchange rate. Interpolation for values not found in this table can be determined from the following formula: $TWA_8=16.61 \log_{10}(D/100)+90$, where D is the percent dose.

It is important to understand that the exposure is interpreted as if averaged over 8 hours. Thus, if a miner only works for 5 or 6 hours, the sound levels can be higher during those hours than if the miner works for 8 hours. Conversely, if a miner works an extended shift (greater than eight hours), the sound levels would need to be lower. Some current models of personal noise dosimeters will provide readings in both dose and the average sound level (L_{avg}) over the sampling period. Although the L_{avg} is useful in some circumstances, it is only equal to the TWA_8 when the period sampled is 8 hours.

Consideration of Hearing Protector Attenuation

Proposed § 62.120(a)(3)(i) would require that when determining a miner's noise dose, the attenuation of hearing protectors not be considered. This provision would supplement the intent of proposed § 62.120(c) to preclude the current practice in the coal industry of not issuing a citation based upon a noise exposure that exceeds the PEL when the miners are wearing hearing protection.

Several commenters recommended that no credit be given for hearing protector attenuation in determining the miner's noise dose. These commenters believed that engineering or administrative controls should be given primacy over hearing protectors.

Other commenters, however, supported an allowance for hearing protector attenuation. Their recommendations varied from allowing the full NRR value, to allowing only a 5 decibel attenuation for all makes and models of hearing protectors.

Field studies in mining by Giardino and Durkt (1996), Kogut and Goff (1994), Giardino and Durkt (1994), Durkt (1993), Goff, et. al. (1986), Durkt and Marraccini (1986), and Goff and Blank (1984) have shown that the measured hearing protector attenuation at mines is far less than the attenuation measured in the laboratory and is in some cases minimal. Furthermore, the measured attenuations were highly variable. These two factors make it virtually impossible to accurately predict the in-mine effectiveness of hearing protectors in reducing noise exposures. A more detailed discussion of hearing protector performance and attenuation rating methods is presented in the *Hearing protector effectiveness* section of this preamble.

Table III–1 presents three types of information from various jurisdictions. These items are—

(1) the consideration of hearing protector attenuation when determining the occupational noise exposure;

(2) the weighting network used for measuring occupational noise exposure; and

(3) the instrument response time for measuring non-impulse/impact occupational noise.

TABLE III–1.—FEATURES OF SELECTED LEGISLATION OR GUIDELINES FOR EVALUATING NON-IMPULSE/IMPACT NOISE TABULATED FOR VARIOUS ENTITIES

Entity	Credit for hearing protector attenuation	Weighting network	Response times
U.S. Army	No	A-weighting	Slow.
U.S. Navy	Implied	A-weighting	Slow.
U.S. Air Force	No	A-weighting	Slow.
Canada (consensus)	Not addressed	A-weighting	Slow (SLM only).
EEC	No	A-weighting	Slow or fast.
Australia (consensus)	No	A-weighting	Fast (integrating SLM) or slow (SLM)
Australia (national)	No	A-weighting	Fast (integrating SLM) or slow (SLM).
Western Australia	No	A-weighting	Fast (integrating SLM) or slow (SLM).
South Africa	Implied no	A-weighting	Slow.
ISO (consensus)	Implied no	A-weighting	Fast (SLM).
ACGIH (consensus)	Implied no	A-weighting	Slow.

In reviewing the procedures for exposure measurement in regulations and codes of practice (mandatory or recommended) from the selected branches of the U.S. armed services, international communities, the ISO, and the ACGIH, MSHA found that some diversity exists among the methods used (See Table III–1). Nearly all of the entities either specify or imply that attenuation provided by hearing protectors should not be considered in determining a worker's noise exposure.

Based on this information, MSHA has concluded that it would be inappropriate to consider the attenuation of hearing protectors in determining a miner's noise dose. As computed, the noise dose provides a measurable foundation upon which can be built a noise control program: including, as discussed herein, the use of hearing protectors to attenuate that noise dose.

This provision would supplement the intent of proposed § 62.120(c) to preclude MSHA's current practice in the coal industry of not issuing a citation based upon a noise exposure that exceeds the PEL when the miners are wearing hearing protection. This is consistent with the thrust of the proposal to establish for all mining sectors a hierarchy of controls for noise in which primary reliance will be upon engineering and administrative controls. These issues are discussed at length in connection with proposed § 62.120(c) under *Hierarchy of controls* and *Hearing protector effectiveness.*

Threshold and Range of Integration

Proposed § 62.120(a)(3)(ii) would require that all sound levels from 80 dBA to 130 dBA be integrated into the

miner's noise dose for determining compliance with the PEL. Sound levels less than 80 dBA would not be included in the noise exposure computation. By not excluding any particular types of sound from the requirement, MSHA intends that the term ''all sound levels'' include, but is not limited to, continuous, intermittent, fluctuating, impulse, and impact noise.

MSHA currently uses a threshold of 90 dBA for all purposes. OSHA, however, uses a dual threshold: a 90 dBA threshold for measuring whether a dose exceeds its PEL (TWA_8 of 90 dBA), and an 80 dBA threshold for determining whether a dose exceeds its action level (TWA_8 of 85 dBA).

Many of the commenters to MSHA's ANPRM supported a threshold of 80 dBA. Some specifically supported a single threshold. One of these commenters stated the following:

> It was an undue burden on employers when OSHA adopted a dual threshold level (90 dBA when sampling for PEL and 80 dBA when sampling for a Hearing Conservation Program). Few employers in our practice understand the difference, and in fact, very few service providers in our area understand the dramatic differences these two threshold levels can create. MSHA has the opportunity to correct this [oversight] by OSHA, and would be wise to adopt the 80-dBA threshold.

Another commenter stated:

> MSHA should use an 80-dBA threshold for integrating noise on dosimeters for both compliance with the PEL and the action level. The exposure characterization of levels between 80 dBA and 130 dBA would be more accurate using an 80-dBA threshold dosimeter versus a 90-dBA integrating dosimeter.

A third commenter recommended the following:

> One threshold level should be used for all measurements—80 dBA. A single threshold level of 80 dBA, as compared to separate thresholds of say, 90 dBA and 80 dBA, would greatly simplify and reduce the costs of measuring noise exposure levels and would provide an additional margin of safety.

Several commenters recommended that the current threshold of 90 dBA be retained. One of these commenters stated the following:

> * * * multiple thresholds would be extremely burdensome and costly and would require companies to purchase and use meters that integrate at different levels. * * * the requirement that more than one threshold be used is unsupported by reliable and widely accepted scientific data and is unnecessary for protection of the health of miners.

Two commenters supported the use of a dual threshold consistent with OSHA's current standard, while another commenter recommended a threshold of 75 dBA, because EPA had said that 75 dBA equates to no risk.

One mining association commented that a member company had collected about 4,500 samples between 1985 and 1988 using personal noise dosimeters set at an 80 dBA threshold and found that about 20% of the measurements equalled or exceeded the PEL. MSHA notes these results are comparable to the results of the dual-threshold survey conducted by the Agency and reviewed in part II.

According to ACGIH (1994) all sound levels exceeding 80 dBA should be integrated into the daily noise exposure. Because permissible durations are presented for sound levels up to 139 dBA, the range of integration can be inferred to be 80 to 139 dBA.

ANSI S1.25–1991, ''Specification for Personal Noise Dosimeters'', recommends that the threshold level be set at least 5 dB below the criterion level. Although ANSI S1.25–1991 specifies personal noise dosimeters to have an operating range of at least 50 dB, most currently manufactured personal noise dosimeters have an operating range greater than 50 dB. In addition, these personal noise dosimeters will integrate sound levels up to 140 dBA to include impulse/impact noise at pre-selected thresholds of 80 dBA, 85 dBA, and 90 dBA.

There is general agreement among the EEC, the ISO, the international community, and selected branches of the U.S. armed services that all types of noise be integrated in the worker's noise dose; however, a threshold is not always specified.

Moreover, based on its review of the available evidence, MSHA has determined that the use of a single 80 dBA threshold for determining a miner's noise exposure is necessary for miner protection. Its many advantages include:

(1) it would address the risk of hearing impairment from prolonged exposure (greater than 8 hours) above 80 dBA;

(2) it would improve the accuracy of exposure measurements, ensuring that at-risk miners would be accurately identified;

(3) it is consistent with OSHA's 80 dBA threshold for HCP requirements, allowing for comparison data;

(4) it would be less burdensome than using dual thresholds, allowing the use of a single, less complex personal noise dosimeter to collect the required information rather than a more expensive instrument or two separate instruments; and

(5) a single threshold is appropriate in as much as MSHA's proposed approach to hearing conservation is linked closely to other parts of its proposal.

Several consequences should be noted of switching to a threshold of 80 dBA from the present threshold of 90 dBA. As noted in part II of this preamble, MSHA inspectors conducted comparative sampling for several years, simultaneously collecting readings at both the 90 dBA and 80 dBA thresholds. Tables II–11 and II–12, located in part II of the Preamble, show the effect of using an 80 dBA threshold versus a 90 dBA threshold with a criterion level of 90 dBA. Of the more than 42,000 samples collected in metal/non-metal mines, for example, 7,360 (17.4%) exceeded a criterion of 90 dBA using a 90 dBA threshold; whereas, 11,150 (26.4%) exceeded the 90 dBA criterion using an 80 dBA threshold. Hence, the use of an 80 dBA threshold will result in a higher proportion of samples exceeding the PEL. Also, an 80 dBA threshold means that in the case of an extended workshift of more than 8 hours, sound levels that average below 90 dBA can result in a dose that exceeds the PEL. For example, the PEL for a 16-hour workshift is 85 dBA, which equates to a TWA_8 of 90 dBA.

Further, based upon research conducted by MSHA, the Agency has determined that the effect of switching to a lower threshold is not linear. Sound levels just under 90 dBA will have a much greater impact on the dose computation than those nearer 80 dBA.

Full-Shift Sample

Proposed § 62.120(a)(3)(ii) would also require that compliance with the PEL or action level be based on the determination of a miner's full-shift noise exposure. Typically, a full-shift measurement would be taken with a personal noise dosimeter. This procedure would be consistent with MSHA's existing noise standards and sampling procedures.

OSHA's noise standard does not specify a sampling duration, other than to require personal monitoring where circumstances such as high worker mobility, significant variation in sound level, or a significant component of impulse noise make area monitoring generally inappropriate. OSHA does require that the sample be representative of the worker's exposure.

In response to MSHA's ANPRM, numerous commenters addressed sampling duration, including the question of novel work shifts (work shifts differing from 8 hours). Many commenters stated that the noise measurement should encompass the entire work shift regardless of duration. For those shifts which exceed 8 hours,

a number of commenters suggested that the PEL be adjusted to account for the longer work shift. Others suggested that the noise exposure be adjusted.

Several commenters advocated the use of a 40-hour noise exposure instead of a daily 8-hour noise exposure because of the widely varying noise exposure of miners. These commenters believed that the 40-hour exposure would present a better representation of the noise exposure.

A few commenters addressed partial shift sampling. At many small mines, miners may be involved with several different jobs with different noise exposures. Because of this, one commenter believed that partial-shift sampling was more representative of a miner's noise exposure. The commenter did not want the highest partial-shift noise exposure projected to a full-shift and reported as the typical exposure for that shift. Another commenter suggested that the survey duration encompass at least two-thirds of the shift in order to represent a full-shift sample.

Lancaster (1986), in a study of noise exposure of British coal miners, reported that the variation in the day-to-day occupational noise exposure of compressed air drillers and electricians had a range that exceeded 30 dBA. The smallest range for any of the fifteen occupations was 8 dBA. Lancaster reported that five-shift samples greatly reduced the chance of getting an unrepresentative high or low result. Further, Lancaster concluded that a five-shift sample was not a reliable routine method for determining the long-term noise exposure. In order to determine the long-term average noise exposure to within an accuracy of 2 dBA, Lancaster stated that 4 to 57 samples are needed depending upon the occupation.

MSHA concurs with the majority of commenters that full-shift sampling is more representative of the noise exposure than partial-shift sampling. Therefore, MSHA has determined that a full-shift measurement is necessary because partial-shift noise surveys do not account for such factors as: variable work tasks, worker mobility, and no set production pattern for many mining situations. These occurrences are commonplace in the mining industry.

The Agency did not include a long-term sampling requirement in the proposal. Such a requirement would be burdensome to the mining industry and is not relevant to compliance with the proposed standard, which will be based upon a single full-shift sample by the Agency. (For further consideration of MSHA compliance policy in this regard, see the last of the Questions and Answers in part I.)

Impulse/Impact Noise

MSHA's proposal does not include a specific limit on impulse or impact noise. Rather, it provides that all noise in the range from 80 dBA to 130 dBA be integrated into a miner's noise dose, including any impulse/impact noises measured in those ranges. Most personal noise dosimeters cover this range of sound levels. MSHA has concluded that, currently, there is not a sufficient scientific consensus to support a separate impulse/impact noise standard. Further, existing procedures, for identifying and measuring such sound, lack the practicality to enable its effective enforcement: for example, many personal noise dosimeters do not permit use of the fast response settings needed to isolate sounds of this type. Since industrial impulses are almost always superimposed on a background of moderate-to-high levels of continuous noise, and since both may be harmful, MSHA has determined that it is only reasonable to consider their effect together, rather than to treat each separately. As indicated below, there is ample justification for this approach in the studies reviewed by MSHA and comments submitted to the record.

MSHA's existing noise standards for coal mines do not include a limit for impulse/impact noise. Both OSHA's and MSHA's Metal and Nonmetal existing noise standards limit impulse/impact noise to a peak level of 140 dB. Neither standard, however, specifically defines impulse/impact noise nor procedures to measure it.

OSHA, in its Hearing Conservation Amendment, determined that impulse noise should be combined with continuous noise to calculate employee noise exposure for purposes of the HCP. OSHA's standard, however, retains the 140 dB peak limit on impulse and impact noise. The OSHA preamble to its Hearing Conservation Amendment (46 FR 4099) stated:

> Since industrial impulses are almost always superimposed on a background of moderate to high levels of continuous noise * * * and since both may be harmful, it is only reasonable to consider their effects together rather than to treat each separately * * *. The decision to measure all noise exposures for purposes of the hearing conservation program is a pragmatic approach to the whole problem of impulse noise. For, while there is some dispute as to the precise definition and effect of impulse noise, there is general agreement that impulse noise is damaging.

Impulse/impact noise is typically characterized by a rapid rise time, high peak value of short duration, and rapid decay.

In 1974, OSHA proposed the following definition for impulse noise (39 FR 37775):

> * * * a sound with a rise time of not more than 35 milliseconds to peak intensity and a duration of not more than 500 milliseconds to the time when the level is 20 dB below the peak. If the impulses recur at intervals of less than one-half second, they shall be considered as continuous sound.

At that time, OSHA proposed to limit exposure to impulses at 140 dB to 100 per day, and to permit a tenfold increase in the number of impulses for each 10-dB decrease in the peak pressure of the impulse. OSHA stated that this proposal was in accordance with the criterion proposed by McRobert and Ward (1973). OSHA's proposal on impulse noise exposure limits was identical to that recommended by the ACGIH (1986).

Currently, there is no uniformly accepted definition of impulse or impact noise. ANSI S12.7–1986, ''Methods for Measurement of Impulse Noise'', defines impulse noise as ''a single short burst or a series of short bursts of sound pressure. The pressure-time history of a single burst includes a rise to a peak pressure, followed by a decay of the pressure envelope.''

The ACGIH (1986) states that:

> Impulsive or impact noise is considered to be those variations in noise levels [sound levels] that involve maxima at [time] intervals of greater than one per second. Where the intervals are less than one second, it should be considered continuous.

Integrating impulse/impact noise into the miner's noise dose is broadly supported by many of the commenters. One commenter stated that currently there is not enough scientific information to promulgate a separate standard on impulse/impact noise. Several commenters advocated retaining the current MSHA Metal and Nonmetal 140 dB peak limit. However, two commenters indicated that exposure to this peak be limited to 100 occurrences per work shift. One commenter on this issue recommended that MSHA adopt the measurement methods described in ANSI S12.7–1986, ''Methods for Measurement of Impulse Noise''. This ANSI document, however, does not specify a criterion level for such noise. Another commenter stated that 156 dB is most likely the critical point at which the sensory components of the human ear disintegrate.

Defining impulse/impact noise, and setting an appropriate limit, has proven to be an arduous task mainly because of the difficulty in measuring such sound and differentiating it from non-impulse/impact noise that may occur simultaneously. Impulse/impact noise

seldom occurs alone in the mining environment. Several commenters on this issue indicated that current instrumentation, including in particular the personal noise dosimeter, cannot distinguish between impulse/impact and continuous noise occurring simultaneously. Some commenters stated that although personal noise dosimeters cannot distinguish between impulse/impact noise and continuous noise, newer models of personal noise dosimeters are capable of accurately integrating the two types of noise into a single combined dose.

The studies reviewed by MSHA and discussed below indicate that even though there is no consensus as to a definition of impulse/impact noise, all researchers and regulators agree that this type of noise is damaging to hearing.

Ward (1990) stated that both impulse and impact noises involve high sound pressure levels and short durations, so in a sense, they jointly represent an extreme type of intermittent noise. He believed, however, that there is considerable evidence that a distinction should be made between impulse noise and impact noise, and that they should be treated separately. Ward characterized impulse noise as ''A-duration,'' such as that from gunfire. Whereas he characterized impact noise as ''B-duration,'' having multiple, nearly equal peaks and a sustained reverberation that may endure for a second or even longer.

Ward believed that recent research tends to support the conclusion that impact noise can reasonably be expected to behave in a manner similar to that of intermittent exposure to short bursts of otherwise continuous but high-intensity noise. He stated that any predictive scheme that accurately estimates the hazard of intermittent noise in the range of time-weighted averages (TWA_8) or $L_{eq,8}$ of 110 dBA to 130 dBA also would be successful in predicting the hazard from impact noise, and no ''correction for impulsiveness'' should be necessary. He further stated, the same is true of impulse noise as long as the level of the pulse does not exceed some ''critical'' value. If the impulse exceeds this critical level, however, Ward believed that the hazard increases rapidly with further increases in level or in the number of impulses.

Ward stated that the most hazardous impulse would be one that has its maximum energy in the most sensitive region of the human auditory system: namely 2000 to 3000 Hz. This occurs when the A-duration is around 0.2 milliseconds (ms). For pulses whose A-duration is in this vicinity, he believed the critical level to be around 150 dB for the average individual and around 140 dB for the most susceptible ears. He believes, however, that his limit results in overprotection against pulses whose A-duration is short (as in the case of cap guns) or long (as with cannons or sonic booms).

Ward concluded that impulse noise may be the most important cause of NIHL in the general population, not by a gradual erosion of auditory sensitivity through repeated daily exposure, but rather by a single event causing acoustic trauma. He emphasized, however, that the determination of valid exposure limits for specific impulses is still a major problem.

In the American Industrial Hygiene Association (AIHA) *Noise & Hearing Conservation Manual,* Ward (1986) also expressed concern regarding an impulse/impact noise limit. He stated:

> Just where, if anywhere, this type of limit should be placed is still undecided. Although the present OSHA regulations state: ''Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure'' (Anon., 1971), this number was little more than a guess when it was first proposed in the CHABA document (Kryter et. al., 1966), and no convincing supportive evidence has since appeared. While 140 dB may be a realistic ceiling for impact noises, it is inappropriate for impulses, so exposure limits in which the permitted peak level increases as the duration of the pulses becomes shorter should continue to be used (Anon., 1968).

Volume II of the Ohio State University Research Foundation report (Melnick et al., 1980) discussed the effects of single, high-level impulses and stated:

> There are insufficient data to develop distributions of hearing loss as the function of the parameters of single, high-intensity impulses. The very nature of the stimulus makes these effects on man difficult to quantify.

This report, however, stated the following regarding single impulse levels that could cause damage:

> * * * In experiments with laboratory animals, impulses having peak levels in the range of 150 to 160 dB were capable not only of producing damage to the inner ear but also showed evidence of trauma to the structures of the middle ear, including perforation of the tympanic membrane (Eames et al., 1973). Pfander (1975) reports that, in humans, perforations of the tympanic membrane were observed when the peak level for an explosive impulse was in the range of 180 dB. In his experiments with the effects of sonic booms on mice using peak levels that range from 126 to 146 dB, with durations in excess of 100 msec, Reinis (1976) reported that five such booms delivered at the rate of 1 every 10 seconds are capable of producing bleeding in the cochlea of the experimental animals.

The Committee on Hygiene Standards of the British Occupational Hygiene Society (1976) developed standards for impulse noise. Their recommendation referenced a study by Kryter and Garinther which ''showed that temporary hearing loss after exposure to 100 impulses increased rapidly at sound pressure levels exceeding 170 dB.'' Kryter and Garinther, however, recommended limiting instantaneous sound pressure levels to 150 dBA, because special measurement techniques and instruments would be needed to measure levels in excess of 150 dBA.

Shaw (1985) recommended, in the interest of simplicity and in keeping with ISO/DIS 1999–1984, that the use of hearing protectors be mandatory where there is exposure to noise at the work place with instantaneous peak sound pressures exceeding 200 pascals (140 dB relative to 20 micropascal). Shaw stated, however, that exposure to many simple non-reverberant impulses (''clicks'') at that level would be required to produce significant temporary threshold shift even in the most sensitive ears. Shaw further discussed the concept of ''critical level'' and stresses that ''the relationship between peak sound pressure level and mechanical or physiological stress * * * is exceedingly complex.'' Shaw quoted McRobert and Ward (1973) who urged that ''* * * damage risk criteria incorporate a more complicated criterion for impulse and impact noise than a simple ceiling or peak level * * *.''

ISO/DIS 1999–1990 (1990) also supported combining continuous noise with impulse/impact noise in conjunction with the use of a 3-dB exchange rate.

In discussing the combined effects of continuous and impulse/impact noise, the ACGIH (1986) stated that:

> Some studies have shown that the effects of combined impulse and continuous noise are additive [Okada et al., *Int. z Angew. Physiol.,* 30:105–111 (1972)]. Other studies have shown that rapidly repeated impulses [Coles and Rice, *Occupational Hearing Loss,* pp. 71–77 (1971)] and simultaneously continuous noise [Cohen et al., *J. Acoust. Soc. Am.,* 40:1371–1379 (1966)] in some cases provide up to 10 dB of protection.

Evans and Ming (1982) and Sulkowski and Lipowczan (1982), however, supported the theory that impulse noise superimposed on steady-state noise is more hazardous than the same levels of either separately. Cluff (1982), professor of audiology at Arizona State University, believed that the combined

continuous/impulse noise dose procedure should be approached with a degree of caution. He stated that:

> The procedure involves some knotty issues; not the least of which is the issue of equal energy (3-dB doubling rule) vs equinocivity (the principle embodied in the 5-dB doubling rule). One other issue deserves mention also. What is impact/impulse noise? It is a simple matter to describe impact/impulse noise in terms of its source when the source is obvious and individual events are spaced far apart temporally. It is quite another matter to describe it differentially from continuous noise when the source is not obvious and when individual events are repeated rapidly (as with the case of gear trains, pneumatic chisels, conveyor belts, grinders, internal combustion engines, etc.). Indeed, this difficulty may be central to the heretofore tendency to class it as continuous noise when the repetition rate exceeds one or two events per second. Were it not that the weight of evidence appears to argue against this approach, the simple thing would be to call it continuous noise and treat it as such.

As shown in Tables III–4 and III–5 (in the section entitled *Permissible exposure level (PEL)*, discussing proposed § 62.120(c)), the majority of international communities and selected branches of the U.S. armed services have adopted 140 dB peak as the upper limit for sound levels in their respective regulations. However, there is no consensus among these regulators as to a definition of impulse/impact noise.

In reviewing the literature on impulse/impact noise, MSHA found that such noise frequently is divided into two general categories: ''A-duration'' impulses are short duration (measured in microseconds) and non-reverberant in that they usually occur outside or in a sound deadening environment; and ''B-duration'' impacts are of longer duration (measured in milliseconds) and are reverberant mainly because they occur inside where the sound is augmented by reflections from hard surfaces. MSHA's experience indicates that there is seldom impulse noise of A-duration in mills and underground mines, because of the reverberant field. Scheduled blasting at surface mines would not be impulse noise of A-duration because of the multiple detonations several milliseconds apart in a semi-reverberant field when considering the rock walls and floor.

MSHA is concerned about the practicality of enforcing an impulse/impact noise limit in mining. Distinguishing impact/impulse noise from continuous noise, according to most of the definitions discussed above, would require sophisticated, delicate laboratory instrumentation. This equipment is: cumbersome, not intrinsically safe, not readily available, and not capable of withstanding the harsh mining environment.

As pointed out by some commenters, there have been many technological advances in the capabilities of noise measuring instruments, and equipment now exists that can integrate impulse/impact noise into the dose. The ability of personal noise dosimeters to accurately integrate sound levels above 130 dBA into the noise dose, however, may be questionable. ANSI S1.25–1991, ''Specification for Personal Noise Dosimeters'', specifies that personal noise dosimeters must have an operating range of 50 dB. ''Operating range'' is defined by ANSI as the range between threshold and an upper sound level within which a personal noise dosimeter operates within stated tolerances. Accordingly, if an 80 dBA threshold is used, current personal noise dosimeters would be required to meet ANSI tolerances up to 130 dBA.

As stated previously, MSHA has determined that there is little noise in mining that could be characterized as impact or impulse given their prevailing definitions. One source of impact noise that may exceed the existing 140 dB criteria is that caused by blasting in underground mines. MSHA has determined that noise from blasting in underground mines would be considered impact noise rather than impulse noise because of the highly reverberant environment.

In Volume II of the Ohio State University Research Foundation report (Melnick et al., 1980), Melnick et al. states the following with regard to measuring impulse/impact noise, such as that produced by blasting:

> Under conditions sufficient to produce measurable hearing loss, it would be extremely fortuitous if measuring instruments were in place to permit the assessment of the actual exposure of the single impulsive event. Generally, these exposures are accidental in nature.

Because blasting occurs at irregular intervals, with most miners removed from the blast site prior to its initiation, it would be difficult for MSHA to measure such exposures and to enforce a limit designed to protect against such exposures.

MSHA considered many factors in determining the merit of proposing an impulse/impact noise limit for the mining industry. Although there is much evidence in the literature on the harmful effects of impulse/impact noise, MSHA concluded that, currently, there is not a sufficient scientific consensus to support a separate impulse/impact noise standard. Further, existing procedures for identifying and measuring such sound lack the practicality to enable its effective enforcement. This is due, in part, to the complexity of the phenomena, where consideration must be given to such factors as: the peak sound pressure level; the wave form and crest factor; the rise and decay time; whether it is A-duration or B-duration; the number of impulses per day; the presence or absence of steady-state sound; the frequency spectrum of the sound; and the protective effect of the middle ear acoustic reflex.

In conclusion, studies discussed above indicate that when impulse/impact noise is combined with continuous noise, hearing loss is exacerbated. Therefore, MSHA has determined that, for purposes of this proposal, impulse/impact noise should be combined with continuous noise for purposes of calculating a miner's noise exposure. Since industrial impulses are almost always superimposed on a background of moderate-to-high levels of continuous noise, and since both may be harmful, it is only reasonable to consider their effect together, rather than to treat each separately. There is ample justification for this approach in the studies reviewed by MSHA and comments submitted to the record.

MSHA, however, requests further comment on this issue, particularly on impulse/impact noise sources in mining which may not be integrated adequately into the miner's noise dose. Additionally, MSHA requests data addressing a critical level to prevent traumatic hearing loss; what this critical level should be; whether it should be based on a single event; and a practical scientifically validated method for its discrete measurement.

Exchange Rate

The exchange rate is another factor which is involved in the determination of noise dose. The exchange rate is the change in sound level which corresponds to a doubling or a halving of the exposure duration. For example, using a 5-dB exchange rate, a miner who receives the maximum permitted noise dose over an 8-hour exposure to 90 dBA would be determined to have accumulated the same dose as a result of only a 4-hour exposure at 95 dBA. If the exchange rate were reduced to 3-dB, the same dose would be received with a 4-hour exposure at only 93 dBA. Other terms for exchange rate include ''doubling rate,'' ''trading ratio,'' and ''time-intensity tradeoff.''

The Agency currently uses a 5-dB exchange rate. There appears to be a concensus in the recent literature for an exchange rate of 3-dB, although the Agency is seeking additional

information on this point. Moreover, the current 5-dB exchange rates incorporates an assumption that there is significant time for hearing to recover from high sound levels. MSHA has concluded that noise exposure under mining conditions does not warrant such an assumption. A 3-dB exchange rate does not incorporate this assumption.

Nevertheless, the Agency is proposing to retain the existing 5-dB exchange rate because of feasibility considerations. Changing to a 3-dB rate from a 5-dB rate would significantly reduce the amount of time that miners could be exposed to higher sound levels without exceeding the permissible exposure limit. For example, MSHA estimates that the percentage of miners whose exposure would be in violation of a PEL set at a $L_{eq,8}$ of 90 dBA would be just about double that of a PEL set at a TWA_8 of 90 dBA. This means mine operators would have to utilize controls to reduce exposures to the PEL more frequently—and the controls required to reduce exposures that much would be more expensive. Furthermore, it is extremely difficult to reduce the noise exposures to below a $L_{eq,8}$ of 90 dBA using currently available engineering or administrative noise controls or a combination thereof. Accordingly, moving the industry to a 3-dB exchange rate may be infeasible at this time. (Part IV contains a further discussion of feasibility issues.)

OSHA, in its 1974 proposed noise standard (39 FR 37774), stated the following regarding its decision to use a 5-dB exchange rate:

> EPA recommended [in response to OSHA's proposal] a doubling rate [exchange rate] of 3 dB. While the 3-dB doubling rate is hypothetically correct for uninterrupted noise exposure, noise exposure in industry is normally interrupted since there are several breaks in the day's work. OSHA agrees with the Advisory Committee [Standards Advisory Committee on Noise, appointed by the Assistant Secretary for OSHA] that the doubling rate should be adjusted to take into account the various breaks which occur in a workday. Therefore, OSHA believes that a doubling rate of 5 dB is more appropriate than the 3 dB.

MSHA received numerous comments regarding this particular issue. Many refer to scientific studies showing the ability of the ear to recover from temporary shifts (temporary threshold shifts, or TTS) incurred during noise exposure. TTS should not be confused with PTS, which refers to permanent theshold shifts—i.e., loss of hearing acuity. Whether TTS and PTS are inexorably linked is a subject of debate, as noted below.

Many commenters advocated retaining the existing 5-dB exchange rate. Two of these commenters believed that there is sufficient support in the scientific literature for a 3-dB exchange rate, but recommended that MSHA retain using the 5-dB exchange rate so as to maintain consistency between MSHA and OSHA.

A number of commenters, however, recommended a 3-dB exchange rate. Several stated that it has greater scientific and technical validity. Others supported the 3-dB exchange rate because it would be in agreement with regulations in many countries outside the United States and with the recently issued international standards [International Standards Organization, ISO 1999.2] which the U.S. endorsed. One commenter asserted that the ''use of the 3-dB, rather than a 5-dB, exchange rate facilitates the calibration/characterization and the interpretation of the performance of such [noise measuring] instruments.'' Another commenter criticized the theory that the 3-dB exchange rate only applies to steady state noise, stating the following:

> First, steady and intermittent noise merely identifies the extremes of episodes of noise and quiet that most workers experience in the course of a day. It is the rare exception to find workers who experience either continuous or steady state noise. Recovery from noise-induced damage, therefore, is unpredictable in the real world. Second, the hypothesis of recovery during intermittent noise exposure has not been empirically verified.

Other commenters stated that the use of the 3-dB exchange rate is not appropriate in mining because exposures in the mining industry are intermittent and, therefore, miner recovery from temporary threshold shifts occurs during the working day. Finally, two commenters stated that if the exchange rate were lowered, many of the personal noise dosimeters currently in use would become obsolete and would have to be replaced.

MSHA reviewed several recent studies relating to the selection of an exchange rate. Kryter (1984) in his discussion of interruptions in and durations of daily noise exposures, asserts that even short periods of reduced noise exposure during the workday facilitate recovery, and that a 5-dB exchange rate is thus appropriate to take this into account. He states:

> * * * it does not matter whether the off time is continuous or interrupted during the 8-hour day. In either case, the recovery process continues and is equally effective. For example, the level of a noise of 8 hours duration per workday could be increased by 6 dB and cause no additional PTS provided its duration is decreased to 4 hours, either by reducing the total work period by 4 hours or by introducing ''off'' periods (longer than 10 sec each) which total 4 hours. This, of course, is in reasonably close agreement with the ''5 dB exchange'' that would be allowed in some noise assessment procedures, such as the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) regulations.

Dear (1987) supported retaining the 5-dB exchange rate based upon the studies of Sulkowski (1980), Gosztonyi (1975), Scheiblechner (1974), Schneider (1970) and Pell (1973). Further, Dear believed that the studies of Passchier-Vermeer (1973) and Burns and Robinson (1970), which formed the basis for Shaw's recommendation to adopt a 3-dB exchange rate (discussed below), were critically flawed and furthermore the findings of Passchier-Vermeer did not agree with those of Burns and Robinson. Dear asserted that Shaw discounted other studies which showed that the 5-dB exchange rate correlated well with hearing loss. Dear claimed that for every study which supports the 3-dB exchange rate, another supports the 5-dB exchange rate. Dear further contended that a 3-dB exchange rate was valid only for workplaces with no intermittent noise exposure, which is a condition that rarely exists in American workplaces.

Sataloff et al. (1984) studied the effect of intermittent noise exposure on the hearing acuity of workers. This study corroborates an earlier report, done by Sataloff et al. (1969) on the hearing acuity of rock-drilling miners, that intermittent noise is not as hazardous as continuous noise of the same intensity. In the more recent study, 295 industrial workers who did not use hearing protectors were exposed to non-impact sound levels from 99 dBA to 118 dBA with quiet periods less than 90 dBA. Most of the workers were exposed to the higher sound levels. The researchers concluded that intermittent noise exposure produced little hearing loss at frequencies below 3000 Hz; however, it produced substantial damage at the higher frequencies. The pattern of damage, exhibited by workers exposed to continuous noise, was also realized at the lower audiometric frequencies. The researchers attributed the difference in patterns of damage to the recovery of the hair cells in the cochlea during quiet periods in the workers exposure to intermittent noise.

Sataloff et al. (1984) also compared the hearing loss of a population of 295 workers exposed to intermittent noise to other studies on workers exposed to continuous noise conducted by Royster et al., Botsford, and Johnson and Harris'